

PC PRO

SAMSUNG GEAR VR IN-DEPTH REVIEW p68



- **Your Windows annoyances solved** p60
- **The secret to creating brilliant apps** p54
- **Buyer's guide: business printers** p96
- **How to create pro-quality videos** p34

**1
SUITES
TESTED**

NIT! VIRUS

ARE YOU AT RISK?

**FIND OUT WHICH
SOFTWARE MISSED 41%
OF ATTACKS**



**Amazing £80
Windows tablet**

Full Windows 8.1 power at an
incredible price – full review p78

**In praise of the
unsung heroes**

The computing pioneers
you've never heard of p42

ISSUE 246 APR 2015



£4.99



Scanning a sea of documents. Xerox makes it simple.

Considering the amount of documents you work with every day, we know scanning can get in the way of your work. That's why Xerox offers a wide range of scanning solutions equipped with all the industry-leading tools you need to make scanning easier and faster. So you can keep moving—no matter how many documents stand in your way.



- Xerox® DocuMate® 4799**
- 112 ppm / 224 ipm at 300 dpi
 - A3 (11" x 17") paper size



- Xerox® DocuMate® 4790**
- 90 ppm / 180 ipm at 200 dpi
 - Compact design



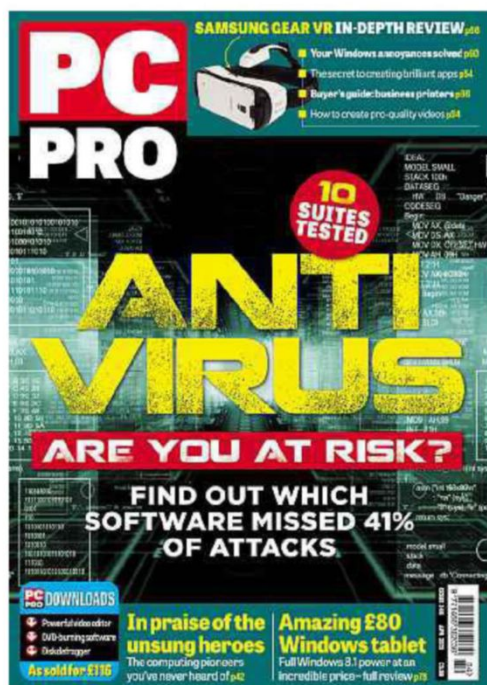
- Xerox® DocuMate® 5460**
- 60 ppm / 120 ipm duplex scanner
 - ID-Card and long document scanning

xeroxscanners.com

Ready For Real Business



In this issue



→ **PC PRO PODCAST**
Don't forget to download the latest *PC Pro* podcast. There's a new show available every Thursday from pcpro.co.uk/podcast



FEATURES

COVER STORY

42 In praise of the unsung heroes

We celebrate the heroes of computing who paved the way for today's IT success stories.

COVER STORY

54 The truth behind app development

What differentiates an also-ran app from an all-time great? We speak to the professional app developers to find out.

COVER STORY

60 Windows annoyances solved

Windows is a powerful OS, but it has some infuriating quirks and gotchas. Microsoft MVP Mike Halsey shows how to make it behave.

PROSPECTS

COVER STORY

34 PowerDirector 11 LE

We introduce the professional-grade video-editing suite that headlines this month's software downloads.

38 Ditch messy spreadsheets and switch to a database

We show how to migrate chaotic sheets of business data into a structured database.

41 Careers: SEO consultant

Shawn Harding explains how he helps businesses improve their discoverability online.



BRIEFING

10 Windows 10: a fresh start for existing customers – and it's free

Microsoft has unveiled its new OS – including a new browser and a virtual-reality headset – and confirmed a move to rolling updates.

14 CES Special: Is the Internet of Things a dream or reality?

We attempt to separate the smart thinking from the hype at CES 2015.

18 Microsoft's court battle

Is the tech giant's data dispute an important privacy test case or a futile PR exercise?

PROFILE

24 YouView

YouView is proving that a British technology firm can match the internationals when it comes to TV services – and the best is yet to come.

VIEWPOINTS

26 DARIEN GRAHAM-SMITH After years in the doldrums, virtual reality is here to stay.

27 JONATHAN BRAY Why isn't the motor industry forging ahead with in-car tech?

27 NICOLE KOBIE CES showed that, without better security, smart devices are stupid.

28 DICK POUNTAIN The fine-art world could help us trace child-abuse images online.

→ SUBSCRIBE: THREE ISSUES FOR £1

Subscribe to *PC Pro* today and you can benefit from our three issues for £1 offer – visit subscribe.pcpro.co.uk now.



TP-LINK®

The Reliable Choice

DO MORE, FASTER

Archer C9

1.9GBPS AC ROUTER

IDEAL FOR WORK AND PLAY

FEATURES:



TARGETED Wi-Fi

Beamforming targets the signal to your wireless devices for the ultimate connection



SIMPLE NETWORK MANAGEMENT

The Tether App controls network settings and permissions from mobile devices



EASY USB SHARING

USB 2.0 and USB 3.0 ports to easily share files, printers and storage



NETWORK EXPANSION

4x Gigabit LAN ports
1x Gigabit WAN port for super-fast wired connections



amazon.com



dabs.com

ebuyer.com
technology delivered



24/7 Technical Support 0845 147 0017
Support Email: support.uk@tp-link.com

uk.tp-link.com
info@tp-link.com

68 Samsung Gear VR: virtual reality hits the mainstream



REVIEWS/LABS

HEADLINE REVIEWS

Samsung Gear VR	68
Windows 10 preview	70
HP Envy x2 13	72
Dell Venue 11 Pro 7000	74
Chillblast Fusion Nano	75
Asus ZenWatch	76
Bush MyTablet 8	78
Linx 10	79

ANTIVIRUS SOFTWARE

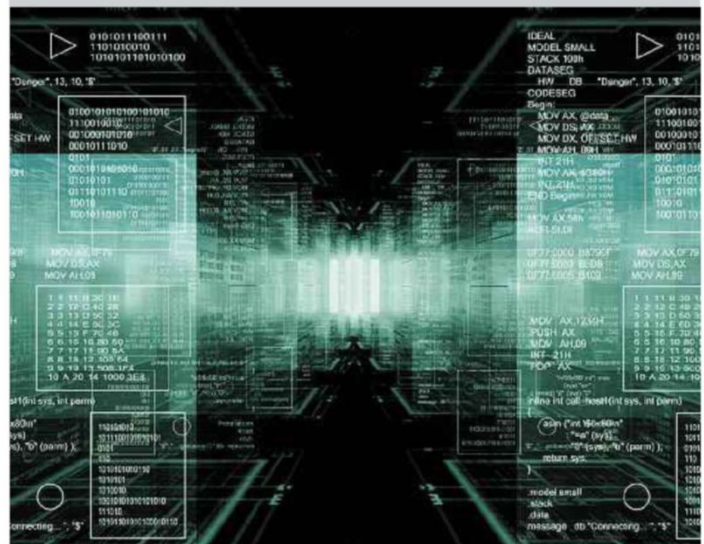
Kaspersky	
Internet Security 2015	88
Avast Free Antivirus	89
360 Safe Internet Security	90
AVG AntiVirus Free 2015	90
Bitdefender	
Internet Security 2015	91
Eset Smart Security 8	91
McAfee Internet Security	92
Microsoft Security Essentials	92

72

Norton Security 2015	93
Trend Micro	
Maximum Security	93

MFPs

Brother MFC-J5720DW	
Business Smart	98
Epson WorkForce	
Pro WF-5620DWF	99
HP Officejet Pro 8620	100
Oki MC562dnw	101
Ricoh SP C252SF	102
Xerox	
WorkCentre 6605DN	104



80 LABS: ANTIVIRUS COVER STORY

Online security threats are more diverse than ever – and the leading internet-security specialists are working flat out to neutralise emerging attacks. But which packages can you trust to protect your devices?

REAL WORLD COMPUTING

110 JON HONEYBALL Reasonably priced, Buckingham-produced GPS equipment shows that European companies still create some of the best technology in the world.

113 PAUL OCKENDEN Virtual reality may finally be hitting the technology mainstream – for less than £3, you can even turn your phone into a headset.

116 NICK DALE A background in aerodynamics and open-source software is all that's needed to create a prototype car – with a little help from some friends.

118 DAVEY WINDER Do you really know what your apps are doing with your data? A few tools can help you get a grip on your mobile security.

120 STEVE CASSIDY Two traumatic recovery processes leave our correspondent unsure how to feel about the state of the technology industry.

REGULARS

Editor's letter	7	Subscriptions	66
The A-List	20	Coding challenge	129
Readers' comments	30	One last thing...	130

THE NETWORK

COVER STORY

96 The right MFP for your business

A business printer isn't just about fusing toner onto a page. We explain how the right model will improve quality, workflow and costs.

106 Could you benefit from CRM?

Is customer relationship management useful for the big boys? We ask the experts what CRM has to offer, and how to get the best from it.

108 Cheat Sheet: Security as a Service

Modern security is more than just installing antivirus software on your workstations.

FUTURES

124 Kick-starting the UK's start-up revolution

We reveal how the new Digital Catapult Centres in London, Bradford, Brighton and Sunderland will help technology companies find their feet.

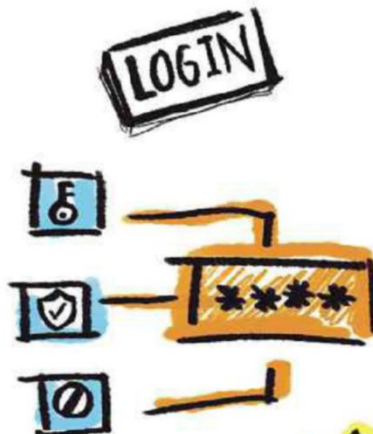
126 Light-speed PCs and altruistic AI

We put questions to the man leading an all-optical-computing team; and Stephen Hawking and colleagues pledge to protect us from super-intelligent machines.

SAY YES to securing your passwords and data with ShieldToGo®



Say No to the Cloud, online apps and notebooks to manage your passwords



Say Yes to ShieldToGo.
A powerful encrypted USB password and login management tool

Lock!



ShieldToGo®
www.shieldtogo.com



Protecting your passwords and data wherever you go.
Includes up to 8GB encrypted storage, **with no annual licence fee.**

£29.99 - available to buy from
Get 10% off with code 5CWAVE10

amazon.co.uk®

Currently compatible with:  
 Windows 7  Windows 8



Editor's letter

GENERALLY – AND THIS is one of those crucial things that the staff of *PC Pro* are yet to grasp – it's best to agree with your boss. Your instinct should be to nod in appreciation at their immense wisdom, smother them in praise, fetch them a cup of coffee, and then say nasty things about them later.

So when our CEO tweeted me during the Windows 10 press conference (*see p10*) to explain that he'd moved from Windows to Apple, I didn't call him a prize fool. No, I politely enquired why. His answer was surprisingly persuasive: he needs to provide technical support to his whole family – and, like it or not, Apple just works.

Now, James Tye is no Apple fanboy. He's actually a former editor of *PC Pro*; until a couple of years ago, it was a ThinkPad sitting in his office rather than a MacBook.

And while Microsoft would be foolish to base its strategy around one ex-customer, I suspect he's typical of the lost Windowsite. They're lured into the Apple world with a phone or a tablet, and before long they're unboxing a MacBook Pro. Everyone reading this can probably identify someone from their own circle who's done the same.

So how do you win back a lost heart? Simple: produce something even better. To borrow a phrase from a certain Steve Jobs, you create a "magical experience". And it has to be magical within seconds of using it, just as the iPad was compared to every tablet that came before it.

Microsoft knows it can't do this on its own, but it doesn't have to: in partners such as Dell, HP and Lenovo, it has undoubted experts at building hardware. I visited all three companies at CES and, even after many years of looking at metallic boxes containing processors, RAM and shiny screens, I walked away smiling. Our "Picks of CES" on p16 includes some stunning machines.

They had only one problem: the software inside. This isn't a jibe at Windows 8.1 per se, but at Microsoft's failure to create a rival app platform to iOS. There's no killer app; there isn't even an app that can cause mild bruising. The firm is attempting to change that with its "One Windows" strategy, to make it simple for developers to create apps to run across phones, tablets, laptops and even the Xbox – but for the foreseeable future top developers will continue to launch for Apple first. Our interviews with developers, part of our feature on creating great apps (*see p54*), made clear that Windows is barely on their radar. Microsoft needs a groundswell of people who want apps on Windows and are willing to pay for them.

Which is a problem. While some people have come to like the Live Tiles interface in Windows 8's tablet mode, it's about 50 times less intuitive than iOS. Sure, Windows 10 cuts much of the clutter, but new users aren't going to be wowed.

It's also tough to imagine businesses switching en masse to tablets. The IT managers I speak to are still buying laptops and PCs, and they fundamentally want Windows 10 to be an updated Windows 7 that's easier to manage. Only if the idea of writing directly onto a screen takes off will we see an invasion of tablets into businesses.

As for James, he wants a system that's always on, like his iPad, that enables him to do things quickly. There's still a chance that a combination of hardware makers and Microsoft can pull this off. And that would be magical.

Tim Danton
Editor-in-chief

CONTRIBUTORS



Nicole Kobie Could you, or your neighbour, create the next Google? The government is providing support to tech start-ups around Britain. Nicole explains how on **p124**



David Hunt Computer-science tutor David sets our monthly coding challenge (*see p129*), so who are his programming heroes? Find out as part of our feature on **p42**



Dave Mitchell Printers are a vital part of keeping businesses around the world running smoothly. Dave's rigorous testing of MFPs will help you choose the right one. See **p96**



Nick Dale A mix of open-source software, determination and lateral thinking helped Nick and friends to create a highly aerodynamic prototype car. Read his story on **p116**

EDITORIAL

EDITOR-IN-CHIEF

Tim Danton: editor@pcpro.co.uk

DEPUTY EDITOR

Darien Graham-Smith

RWC EDITOR

Dick Pountain: rwc@pcpro.co.uk

BRIEFING & FUTURES EDITOR

Nicole Kobie

REVIEWS EDITOR

Jonathan Bray: reviews@pcpro.co.uk

DEPUTY REVIEWS EDITOR

Sasha Muller

ONLINE EDITOR

David Court

SENIOR STAFF WRITER

Vaughn Highfield

STAFF WRITER

Jane McCallion

ART & PRODUCTION

DESIGNER

Paul Duggan

FREELANCE DESIGN

Rebecca Halverson, Sarah Ratcliffe, Heather Reeves

PRODUCTION EDITOR

Monica Horridge

SUB-EDITORS

Vinny Forrester, Priti Patel

CONTRIBUTING EDITORS

Tom Arah, Steve Cassidy, Jon Honeyball, Simon Jones, Dave Mitchell,

Mark Newton, Paul Ockenden, Kevin Partner, Davey Winder

CONTRIBUTORS

Stuart Andrews, Barry Collins, Nick Dale,
Mike Halsey, Shawn Harding, David Hunt

PHOTOGRAPHY & PRE-PRESS

Danny Bird, Henry Carter, Phil Dawson,

Jenni Leskinen, Russ Nicholas

ADVERTISING TEL: 020 7907 6662

FAX: 020 7907 6600

SENIOR ADVERTISING MANAGER

Ben Topp: ben_topp@dennis.co.uk

ACCOUNT DIRECTOR

Karren Cook: karren_cook@dennis.co.uk

SALES EXECUTIVE

Trishita Shah: trishita_shah@dennis.co.uk

STRATEGIC AD DIRECTOR (DIGITAL)

Paul Lazarra: paul_lazarra@dennis.co.uk

STRATEGIC AD DIRECTOR (DIGITAL)

Julie Price: julie_price@dennis.co.uk

COMMERCIAL DIRECTOR (DIGITAL)

Hannah Dickinson: hannah_dickinson@dennis.co.uk

STRATEGIC AD MANAGER (DIGITAL)

Matthew Sullivan-Pond: 001 646 717 9555

matthew_sullivan@dennis.co.uk

AD PRODUCTION TEL: 020 7907 6055

GROUP PRODUCTION DIRECTOR Robin Ryan

PRODUCTION MANAGER Kerry Lambird

PRODUCTION CONTROLLER Nadine King

CIRCULATION & SUBSCRIPTIONS

Tel: 0844 844 0083 pcpro@servicehelpline.co.uk

CIRCULATION MANAGER Emma Read

NEWSTRADE DIRECTOR David Barker

COVER DISC TECHNICAL SUPPORT

coverdiscs@servicehelpline.co.uk

REPRINTS TEL: 020 7907 6625

Ben Topp: ben_topp@dennis.co.uk

What was your worst computing disaster?

My first, dearly beloved ThinkPad was struck by lightning – it got in via a dial-up phone cable! – and completely fried.

PowerPoint ate my presentation the night before a big management conference. I was up until 4am redoing it.

I once sneezed and spilled Lemsip all over my brand-new MacBook Pro.

The Nimda worm went through McAfee Antivirus like a dose of salts, infected the entire lab and it took two full days to clean up.

Unplugging a very expensive Intel CPU, but forgetting to turn off the power first. No survivors.

I discovered a password stealer on my work laptop. Which explained all the fun people were having in various hotels in America at my expense.

At university, my laptop started running slowly, so I decided to restore the system from a backup. My dissertation draft went from 20,000 words to 3,000, just like that!



EDITORIAL Tel: 020 7907 6000

LETTERS letters@pcpro.co.uk

TWITTER @pcpro

FACEBOOK www.facebook.com/pcpro

SUBSCRIPTION ENQUIRIES 0844 844 0083

PC Pro, 30 Cleveland Street, London W1T 4JD

Dennis Publishing Ltd.

GROUP MANAGING DIRECTOR Ian Westwood

MANAGING DIRECTOR John Garewal

DEPUTY MANAGING DIRECTOR Tim Danton

DIRECTOR OF ADVERTISING Julian Lloyd-Evans

FINANCE DIRECTOR Brett Reynolds

GROUP FINANCE DIRECTOR Ian Leggett

CHIEF EXECUTIVE James Tye

COMPANY FOUNDER Felix Dennis

PRODUCTION & DISTRIBUTION

Printed by BGP. Distributed by Seymour Distribution, 2 East Poultry Avenue, London EC1A 9PT. Tel: 020 7429 4000. PC Pro is published monthly by Dennis Publishing Limited. Company registered in England, number 1138891.

COPYRIGHT

© Dennis Publishing Limited. PC Pro is a trademark of Felix Dennis. This publication may not be reproduced or transmitted in any form in whole or in part without the written permission of the publishers.

SUBSCRIPTIONS

Price: UK £49.99; Europe £70; Rest of World £90. Visit dennismags.co.uk/pcpro for our best offers. To renew a subscription, change an address or report any problems, visit subsinfo.co.uk

LIABILITY

While every care has been taken in the preparation of this magazine, the publishers cannot be held responsible for the accuracy of the information herein, or any consequence arising from it. Please note that all judgements have been made in the context of equipment available to PC Pro at time of review, and that "value for money" comments are based on UK prices at the time of review, which are subject to fluctuation and are only applicable to the UK market.

SYNDICATION & INTERNATIONAL LICENSING

PC Pro is available for licensing overseas. Licensing contact: Nicole Adams, nicole_adams@dennis.co.uk, +44 20 7907 6134. Reprints and syndication: Wright's Media, 0800 051 8327 (toll-free).



CERTIFIED DISTRIBUTION
36,629 (Jan-Dec 2013)



Vigor 2860 Series

The Ultimate 'xDSL' Router

- ADSL2+ and VDSL and broadband router/firewall
- IPv6 support - The new Internet protocol
- 3G / 4G (Cellular) Modem support
- Built-in simultaneous dual-band WiFi
- Comprehensive and robust firewall
- VPN site-to-site and teleworker connectivity
- Configurable QoS (traffic prioritisation)
- 6-Port Gigabit Ethernet Switch
- Content Filtering (by keyword or data type)
- 802.1q VLAN tagging & multiple subnets
- Twin phone ports for VoIP (Option)
- Managed Wireless for DrayTek APs - New



Vigor2760 Series

ADSL/VDSL Router

- ADSL, ADSL2+ & VDSL Router Firewall
- Ideal for SoHo & Teleworkers
- 3G/4G USB Modem Support
- Native IPv4 & IPv6 dual-stack support
- Gigabit Ethernet LAN Ports
- NAS facility using USB-based storage
- Robust firewall with object-base rules
- Dial-out VPN - connect to HQ
- QoS for traffic prioritisation
- Twin phone ports for VoIP ('v' models)
- Internet Content Filtering



Do you use a router or WiFi ?

If you use or operate a router or WiFi network, of any brand, you are a target for hackers or criminals. Read our essential white paper "The 27 things every router user should know". Download it free from

www.draytek.co.uk/best



AP-900 Access Point

Dual-Band Wireless

- Business Class Wireless Access Point
- Simultaneous Dual Band (2.4/5GHz)
- PoE Powered (or DC) as standard
- 4+1 Port Gigabit Ethernet Ports
- Multiple Security Facilities
- Standalone or Centrally Managed
- VLANs & Multiple SSIDs



Vigor2925 Series

Dual-WAN Ethernet

- Dual-WAN Ports (Gigabit Ethernet)
- IPv4 / IPv6 Support
- 3G/4G USB Modem support
- Internet Content Filtering
- Load-balancing & WAN failover
- QoS Prioritisation
- SSL & IPSec VPN



DrayTek Managed Wireless

DrayTek's new managed wireless facility is built into the Vigor 2860 router - Just add DrayTek wireless access points and your users and guests can have reliable coverage and optimised performance, whilst you have control, security and comprehensive monitoring.

- No dedicated/specialist controller required
- Mobility - Wireless throughout your premises
- Load-Balancing across multiple APs
- Reporting, logging & monitoring
- Security & isolated guest access

Learn more at www.draytek.co.uk/wireless



VigorSwitch

Gigabit & PoE Switches

- Gigabit Smart or L2 Managed
- 8 or 24 Port Full Power PoE
- PoE models to power:
 - IP Phones
 - IP Cameras
 - Access Points



Vigor 2960 / 3900

High Performance Routers

- 2 or 4 Gigabit WAN Ports
- Load-balancing & failover
- 500 or 1000Mb/s Firewall Throughput
- 200 or 500 IPSec VPN Tunnels
- SSL VPN
- IPv6 & IPv4 dual-stack
- Internet Content Filtering



DrayTek

For the full range, visit
www.draytek.co.uk

All specifications subject to change. 09/13
Please check web site for current model specifications.

Briefing

Background and analysis on all the important news stories

PM's encryption ban

Experts slam Cameron's plan to limit message security [p12](#)

Internet of Things

Separating the smart thinking from the hype at CES [p14](#)

PC Probe

Microsoft's legal battle: privacy test case or PR exercise? [p18](#)

Windows 10: a fresh start for existing customers – and it's free

Microsoft has unveiled its OS, which includes a new browser and a virtual-reality headset. Perhaps most significant, however, is the company's move to rolling updates. [Nicole Kobie](#) takes a closer look



MICROSOFT HAS REVEALED more details of Windows 10, including the Spartan browser and the HoloLens headset (see opposite).

Windows 10 will be a free upgrade for users of Windows 7 and 8 – news that may cheer those unhappy with Windows 8. But will the changes and new features (see [p70](#) for our preview) be enough to convince customers to stick with Windows?

■ Fresh Start

At a press conference at the end of January, Microsoft confirmed that, during its first year of release, Windows 10 will be free for those upgrading from Windows 7, 8 or 8.1 – but not Vista. Plus, the updates will keep coming. “This is more than a one-time upgrade: once a Windows device is upgraded to Windows 10, we will continue to keep it current for its supported lifetime – at no cost,” executive vice president of operating systems Terry Myerson announced.

“The experience will evolve and get better over time. We’ll deliver new features when they’re ready, not waiting for the next major release. And just like any internet service, the idea of asking ‘What version are you on?’ will cease to make sense.”

This confirmed Microsoft’s intention to move to rolling updates, a switch that “makes sense in today’s consumer-device world,” according to IDC analyst Al Gillen. The idea may not appeal to enterprises, but Myerson promised to “continue to support the way many of them work today”.

A number of the features in

Windows 10 are already well known. However, Microsoft showed off one upgrade that is sure to please: the Start menu features a scrolling area for

Live Tiles, with the option to expand to full-screen to suit tablet-style hardware. Put simply: “It’s much, much improved on what we had before,” said Gillen.

■ This is Spartan

The native browser in Windows 10 will no longer be Internet Explorer, but rather a new one codenamed Project Spartan. Sporting a cleaner look and a new rendering engine,

Spartan features some intriguing new tools. On touchscreen devices, you’ll be able to take notes with a stylus on top of web pages and save them to OneDrive. Microsoft’s voice assistant Cortana will integrate with the new browser, too.

But this doesn’t spell the end of Internet Explorer.

“For some users ... there will be good justification for using either Spartan or IE, and, in rare cases, both products,” said Gillen.

■ Winning back customers

Microsoft has work to do to regain goodwill, but Gillen is “encouraged” by the firm’s approach. Aside from smart headwear and big-screen devices, Microsoft also showed Lumia phones running Windows 10.

“Challenges will come in the mobile arena,” noted Forrester analyst Frank Gillett. “The new OS will provide an unprecedented ability to make apps that work on PCs, tablets and smartphones with a single application development effort. However, Windows 10 doesn’t show enough potential for a differentiated mobile experience that will draw both developers and consumers away from iOS and Android.” ●



ABOVE Joe Belfiore, corporate vice president of the operating systems group at Microsoft, took centre stage at the pre-launch event

“The native browser in Windows 10 will not be Internet Explorer, but rather a new one, Project Spartan”



What is... HoloLens?

Microsoft surprised everyone by revealing the new HoloLens headset only days after Google announced that it was to stop making Glass. The timing couldn't have been better – but what exactly is HoloLens?

Is this Microsoft's version of Google Glass?

Not quite. As one analyst cheerfully pointed out to us, the only real similarity between the two is that both are worn on your head. Glass overlays a small box of information into your vision, whereas HoloLens projects entire 3D objects into the real world, allowing you to play Minecraft on your coffee table or follow maintenance instructions overlaid on a problematic appliance. What's more, you can interact with these 3D virtual models via gestures and voice commands – and via Windows Holographic, Microsoft's interface for the virtual world.

Does this mean Windows is going holographic?

We have enough trouble with touch spreadsheets – imagine spreadsheets projected anywhere! Windows Holographic will project controls for you to work with – think of a miniature Start menu hovering in the air in front of you, from which you can tap to start up Netflix or Spartan. Rather than popping up phone notifications like Glass, HoloLens wants to give you access to your entire PC.

Sounds like the future. How far off is it?

Believe it or not, Microsoft has already given early demonstrations to US journalists; reports indicate that the experience is impressive, but finicky to use. It's planned for release "in the same timeframe" as the rest of Windows 10. Prices have yet to be revealed.

Five stories not to miss

1 Sky's parental controls on by default

Sky will automatically censor web connections for adult content unless requested by customers to turn off parental controls. The UK's second-largest ISP has offered network-level filters since 2014, with new customers given the option over whether they want the filter on. Sky will now give existing customers the same option over email – failure to reply will result in your broadband being automatically filtered.



2 Google stops Glass sales

Google has stopped selling its augmented-reality headset Glass. It said it wasn't the end of the technology, with future versions to be launched "when they're ready". The £1,000 glasses hit the US market in 2013, but arrived in the UK only last year, with Tesco launching an app just days before Google's announcement to pull the product.



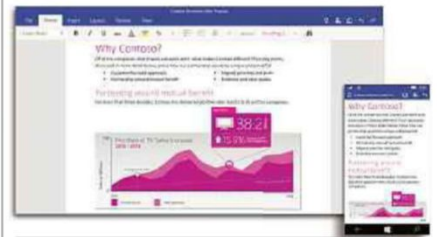
3 Silk Road trial starts in US

The trial of the alleged mastermind of the Silk Road has started in the US, with Ross Ulbricht accused of running the dark-web site that became infamous for selling drugs and cybercrime services. Ulbricht maintains his innocence claiming that, although he developed the website, he'd passed it over to new owners before illegal activity began.



4 Microsoft and Google duke it out over bugs

Google researchers uncovered a bug in Windows 8.1 and gave Microsoft 90 days to fix it before going public – and then released the details just before the company patched it, raising accusations of irresponsible disclosure. Google said the deadline was in place to maintain pressure on firms to patch, while Microsoft said it was merely "gotcha" tactics that ultimately hurt customers.



5 Office 2016 to arrive in 2015

Alongside its Windows announcements, Microsoft said Office 2016 will arrive in the second half of this year. The firm said it will be the "experience you're long familiar with" and will work best with a mouse and keyboard. Meanwhile, "universal" Office apps for touch and mobile are also being prepared for general release later this year, and will be available in upcoming versions of the Windows 10 technical preview.

CUT WASTE

Using fewer and smaller supplies;
WorkForce Pro cuts waste to a minimum.
Better for you and the environment.

JOIN THE PRINTER REVOLUTION
www.epson.co.uk/printerrevolution



EPSON®
EXCEED YOUR VISION

PM's anti-encryption plans cause fury

Bone-headed, dangerous and technology-illiterate – security experts pile criticism on to David Cameron over threat to ban encryption

Following the shootings at *Charlie Hebdo* magazine and a Jewish grocery in Paris, Cameron said: "Are we going to allow a means of communications which it simply isn't possible to read? My answer to that question is: 'No, we must not'."

Cameron hasn't clarified what this means in practice, but his words have sparked speculation that the government may try to force tech firms to drop encryption, particularly for messaging apps such as Snapchat. It could also force sites and apps to include a backdoor for security services.

A number of internet experts have responded: Liberal Democrat MP Julian Huppert said the plan to ban encryption was "technologically illiterate"; sci-fi writer and digital-rights advocate Cory Doctorow said it would "endanger every Briton and destroy the IT industry"; and Ladar Levison, the founder of encrypted email service Lavabit – which chose to shut down rather than hand over user data to the US government – called the move "insane."

■ Backdoors and banned apps

Why would the PM suggest such an extreme plan? F-Secure security advisor Tom Gaffney saw Cameron's pledge as a "gaffe".

"He was repeating what the security services' bosses say about encryption causing them problems," he told *PC Pro*. "What they really want is backdoors and decryption keys so they can access the data. They'd prefer to have this access without needing to go through due process."

While it would be legally possible to ban encryption, technically it would be difficult to enforce. "It would take an army of people to make it work, and that's only if there were complete state control of the internet," said Gaffney. "The moment that happens, freedom of speech and expression are dead and it's no longer a democracy."

Security analyst Graham Cluley pointed out that anyone living in the UK under an encrypted messaging ban could simply download programs from overseas or obtain access to the source code to compile them themselves. "The idea is fundamentally flawed and bone-headed," he said.

Ross Anderson, professor of security engineering at the University of Cambridge, argued that the only way to stop encrypted messaging apps would be to mimic the Chinese and block sites such as Facebook "at the border", sending thousands of police to break down the doors of those using proxies. "That isn't consistent with the Conservatives ever winning an election again."



ABOVE David Cameron's "gaffe" has the security industry up in arms

Backdoor access may seem like a simpler solution, but Gaffney said it made little sense to build something strong and then deliberately weaken it. "You can't have backdoors only for the good guys. Weaknesses can be used by criminals and totalitarian states," he added.

■ What can be done?

Every time there's a terror attack, the government

responds in the same way: "give us more power over communications". What can be done to help security services fight such crimes without breaking the internet? Gaffney said security services need more staff to follow up leads and monitor suspects. "Targeted surveillance is more effective than mass surveillance."

Cluley argued that privacy is worth protecting, even at the risk of terror attacks. "I'm not expecting the authorities to stop all terrorism. Just like I'm not expecting you to stop domestic abuse by planting cameras in every household in the country."

High speeds, high prices: what the O2-Three deal means for the UK

THE CORPORATE GIANT behind Three has bid £10.25 billion to buy O2, weeks after BT bid £12.5 billion to pick up EE, the 4G-focused joint venture between T-Mobile and Orange.

The deals are expected to be approved by regulators, meaning Britain's mobile market will shrink to only three players. Here's what the two deals mean for the state of the mobile market – and for consumers.

The tie-up between O2 and Three would make the resulting mobile behemoth the largest operator in the UK, with a total of 31.5 million customers. At the moment, EE is the largest mobile operator, with 28 million customers, of which 7.7 million are on 4G.

Analysts have warned that consolidation often leads to higher costs for users, with prices in Austria rising noticeably in the two years



since Three bought a rival there, the *Financial Times* noted. In the past, the UK market has been highly competitive, with Three, in particular, helping to drive down costs. "Fewer players in an essential market such as telecoms is rarely a good thing for consumers and competition," said *Which?* executive director Richard Lloyd.

ABOVE With a market consisting of only three players, consumers are likely to see higher prices

In terms of marketing, users will continue to see once-dominant brands phased out, with fewer than one in ten new EE customers now signing up under either T-Mobile or Orange. A BT source told the *FT* that the telecoms giant would continue that process – and might stop selling 3G contracts in favour of 4G only.

Ovum analyst Matthew Howett noted that the Three and O2 tie-up would "result in a concentration of the lower-frequency spectrum (ideal for providing coverage), yet would have no higher-frequency spectrum at 2.6GHz, which is needed given consumers' insatiable appetite for data." He added: "Interestingly, a merged BT and EE would have the lion's share of that higher-frequency spectrum and, as part of that transaction, would also likely have to give up some of the airwaves."

JOIN THE PRINTER REVOLUTION

Epson inkjet. Better printers for business

Join us and say goodbye to the past.
Free yourself from printers that slow
you down and guzzle resources.

Say hello to the future.
The WorkForce Pro costs less per page,
uses less power and prints faster*.

- 50% more economical*
- 80% less power usage*
- Low intervention
- Fewer points of failure
- Clean technology
- Less waste



PRECISIONCORE



**Choose the WorkForce Pro.
Choose the future.**

www.epson.co.uk/printerrevolution



EPSON®
EXCEED YOUR VISION



CES Special

Internet of Things: dream or reality?



The tech industry is rushing headlong into a world full of connected “things”.
Tim Danton attempts to separate the smart thinking from the hype at CES 2015



SOMETIMES TECH COMPANIES have brilliant ideas, produce perfect products, and still can't convince consumers to buy them. Back in 2010, CES pushed 3D TVs as the next big thing. Trouble is, no-one bought them.

This year, the monstrous Vegas technology show was full of the Internet of Things (IoT) – but will firms be able to convince consumers to connect every aspect of their lives?

Make no mistake, tech companies' vision of the future is that nigh-on everything will be connected. At Samsung's CES keynote, co-CEO Boo-Keun Yoon claimed that 90% of the company's products would be able to connect to the internet by 2017. And that includes fridges and washing machines.

“In the five-year view, it's about a connected experience,” Charlene Marini, vice president of marketing for ARM's embedded devices, told us at CES. “That is, the increasing merger of our physical and digital worlds – that's what we see IoT as being about. Our ability to understand context

from the physical world – such as temperature, motion, humidity – and also to be able to control our physical world to some extent.”

■ The hub of the home

The key to all this connectivity is the so-called hub, a box of some description that will sit in your home

ABOVE Samsung co-CEO Boo-Keun Yoon stressed the company's commitment to connected devices

and, like the puppet master, control all those connected devices: the heating, your fridge, your security systems and so on. Samsung likes this idea so much it bought home-automation specialists SmartThings back in August 2014.

Broadcom, which specialises in system-on-a-chip solutions, was meanwhile pushing a vision of set-top

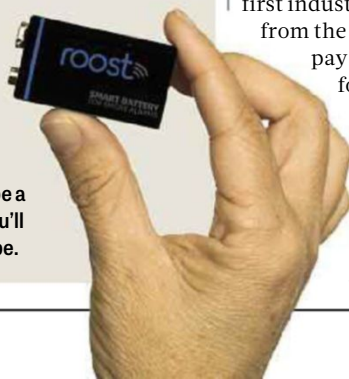
“**Samsung claimed that 90% of the company's products would connect to the internet by 2017**”

boxes as the hub at CES. That has a logic to it: after all, your set-top box is connected to your internal network and your broadband, and offers a payment system through your service provider. It also offers a handy display. “When you're ready to retire in the evening, you might want to see what's going on in your house,” said Stephen Palm, senior technical director at Broadcom. “We have the [wireless protocol] ZigBee in the set-top box, so you could design a whole new security system with ZigBee motion detectors and sensors like that.”

Home security may well be the first industry to quickly see a shift from the traditional model: why pay a separate monthly fee for a service that can be handled by your ISP as part of the bundle? “In the US, people are paying \$30 per month for these services – it basically dials out if there's an alarm and it has someone

Meet the smart battery

One interesting tech at CES was the Roost Smart Battery (smartroost.net), which on the surface looks like the conventional 9V battery inside your smoke alarm. Its makers have integrated Wi-Fi into the design and added a smartphone app, which means that if there's a problem, whether that be a low battery or a genuine emergency, you'll know about it wherever you happen to be.





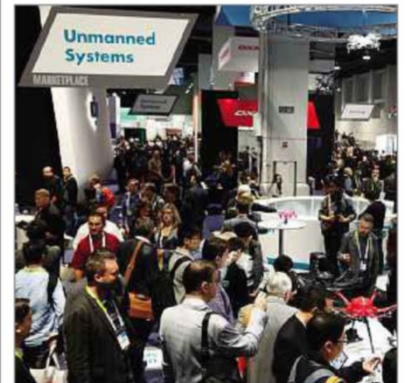
call the police," said Palm. "They're charging \$300 per year to do that. The video-service providers could certainly provide that service through their broadband connection, and a much nicer user interface, and connect to video cameras." When you factor in support for presence through NFC and Bluetooth in people's phones, it's a smarter solution than today's dumb on/off security alarms.

Such a setup seems a far more compelling argument for connected homes than a smart fridge that tells you to buy some eggs. "There are applications that make sense, and

ABOVE & RIGHT
Visitors flock to the stands at CES to see smart wearables and home-automation systems

"If we're talking about consumers, psychology and culture have a lot to do with it"

ones that don't make sense," said Marini. "If we're talking about consumers, psychology has a lot to do with it, so there are going to be things that just don't work. This can't be a push. It has to be something consumers want."



And that's what manufacturers must recognise before they foist their vision of the Internet of Things into our homes – and our lives: solve a real problem and we'll buy. Create a technology that doesn't solve a problem, and you'll end up with unsold stock to join the warehouses full of unsold 3D televisions.

Introducing Intel Curie

Another CES sees another wearable technology from Intel. So what's the difference between Curie and Edison, which Intel announced last year?

Edison is the size of an SD card, but Curie is even smaller – the size of a button, as Intel demoed at CES. And whereas Edison was designed for the Internet of Things as a whole, Curie is all about wearables.

So what will I be wearing?

It could be embedded into pretty much anything: buttons, rings, handbags, fitness trackers or pendants. As an indicator of the company's thinking, Intel has already created a luxury "smart bracelet" and has an established partnership with Fossil. "Wearables are ultra-personal," said Intel CEO Brian Krzanich in his keynote.

What exactly is inside?

There's Bluetooth LE, 384KB of flash memory and a six-axis sensor with an accelerometer and gyroscope – but the key component is Intel's all-new Quark SE



system-on-a-chip, adapted from the Quark SoC created for Edison. Mike Bell, Intel vice president for new devices, said the company had needed to "fundamentally re-architect some of the ways the pieces inside the chip play together to work the ways wearables work", and part of that challenge was battery life. This device needs to be always connected,

so it was vital to be able to shut down parts of the SoC when they aren't needed.

Talking of battery life...

All Intel is saying so far is that Curie "can run for extended periods from a coin-sized battery". But, with battery-charging circuitry built in, it's safe to say that you'll need to keep that charging cable close by.

And when can I get my hands on one?

Intel is pushing hard on wearables – for example, rather than relying on each company to create its own software, it's supplying a real-time operating system that works with the chip – but manufacturers that want to integrate Curie into their designs will have to wait until the second half of the year to get their hands on modules. Therefore, we're unlikely to see Curie-based wearables until next year.





CES Special

2015 top picks: the 10 best products and innovations

Thousands of products were launched at CES, but only ten garnered a *PC Pro* award. Here, we celebrate the very best



★ Best laptop

HP EliteBook Folio 1020

Forget what you consider to be a business laptop: the Folio is part of a new breed of sleek, sexy ultraportable, with Intel's Core M processor taking a starring role. It's this, along with a CNC aluminium chassis, that helps the 1020 to a sub-1kg weight. All this would mean nothing if it weren't a pleasure to use in practice, but a top-quality keyboard and vibrant IPS screen ensure this won't be a problem. Pricing and availability are still to be confirmed as we go to press, and we'll have to wait until we get the laptop into our labs before can determine if its battery lasts the nine hours HP claims – but so far, so fantastic.



★ Best phone

Asus ZenFone 2

We had to double-and triple-check the price, but it's true: Asus claims this stunning-looking 5.5in phone will cost as little as \$199 (around £131). The company hasn't compromised on the core specifications, with 2GB of RAM for the base model – a 4GB version will be available – and an Intel Atom processor inside. Storage will range from 16GB to 64GB, and there's a microSD slot to potentially expand that by another 64GB. Even more remarkably for such a cheap phone, it looks and feels like a premium device – helped in no small part by a 1080p IPS display. It will arrive in the US in March; the UK release date is yet to be confirmed.



★ Best convertible

Toshiba Satellite Click Mini

If you want to travel with a tablet and a fully fledged laptop, then you have two choices: separate devices or a two-in-one. The latter design is starting to build momentum, and now Toshiba has joined the fray with the stylish Satellite Click Mini. It's light – just under 1kg in laptop mode; 470g as a tablet – and Toshiba claims a stunning 16-hour battery life. We also love the 8.9in IPS display, with a generous 1,920 x 1,200

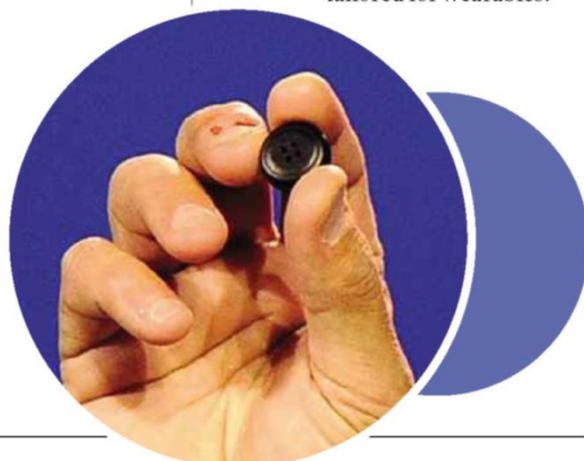


resolution. Our one caveat is that hitting small Windows 8.1 UI features – when you want to minimise windows, for instance – is a pain with a finger. A well-sized keyboard and Atom processor are both good enough for everyday use, making this a bargain at £249 inc VAT.

★ Best innovation

Intel Curie

Last year Intel took our top innovation award with its development platform Intel Edison – including a 22nm SoC (system on a chip) for the Internet of Things. This year it repeats the feat by creating a button-sized module with an enhanced version of Edison's SoC tailored for wearables.

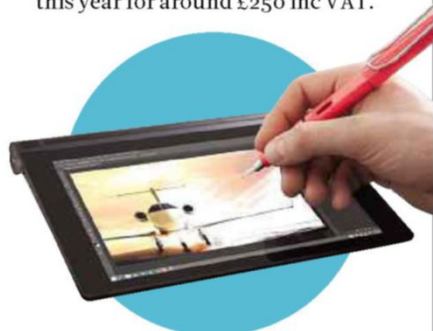


As we discuss on p15, Curie is a brilliant little innovation, making it simple for manufacturers of wearable tech – think anything from bracelets to fitness trackers – to build their devices without having to worry about the core technology. It's small, yet potentially very, very big.

★ Best tablet

Lenovo Yoga Tablet 2 AnyPen

With so many tablets launched at CES, the winner of our Best Tablet award needed something a little bit extra special. And the Lenovo Yoga Tab 2 AnyPen has that in spades. Which, coincidentally, you could use to write on the screen, because this tablet doesn't need a stylus to work: it works with any tip capable of conducting electricity. That could be a pencil, a biro, even a screwdriver – and yes, that was part of the demo we saw at CES (pcpro.link/246anypen). A special finish on the 8.9in display prevents scratches, while an Intel Atom processor helps this Windows 8.1 tablet to 15 hours of battery life. We're expecting it to go on sale early this year for around £250 inc VAT.



★ CES Top Pick

Asus Transformer Book T300 Chi

So nearly the winner for Best Convertible, this 12.5in device is the largest in a new range of two-in-one Transformer Books that Asus announced at CES. What makes it more interesting than the 8.9in T90



and 10.1in T100 is that it's fully usable as a main laptop. While we struggled to type on the smaller machines' keyboards, the T300's is a full-sized affair with a decent feel to the keys. What's more, it's powerful enough to be your main PC, featuring a Core M processor, and a great 12.5in display – the sample we saw had a 2,560 x 1,440 resolution, but a Full HD version will be available. You can buy it now in the US from \$699 (around £460); UK availability will follow soon.

★ CES Top Pick

3D Sound Labs Neoh headphones

With products such as the Samsung Gear VR (see p68), we're starting to see the emergence of "immersive" visual environments. But what about audio? That next step could come thanks to companies such as 3D Sound Labs. It's been working on a way to make surround sound a possibility in headphones – so, when you move your head to look at something, the "sound field" moves to match. Look out for a Kickstarter campaign soon, where you'll be able to pre-order a set with "extremely attractive early-bird special deals".



★ CES Top Pick

Nvidia Drive PX

Autonomous cars drove one street closer to reality at CES 2015, with Nvidia launching a technology that could be the force behind the next generation of cars. Drive PX features two of Nvidia's "super chip" Tegra X1 processors, which means it can handle up to 1.3 gigapixels of visual data per second – enough to cope with a dozen 2-megapixel cameras at 60fps dotted around the car. That's matched with image-processing tech to build a map of the car's surroundings on the fly, allowing it to auto-park, detect other vehicles by make and model, and take action to avoid obstacles.



★ CES Top Pick

Dell XPS 13

The 2015 update to Dell's familiar XPS 13 range has one stand-out feature: its stunning screen. Dell refers to it as an "infinity display", because the 5mm bezel on every side comes very close to making it look like it doesn't have an edge. Nor is this just for looks: it means the all-new XPS 13 squeezes a 13.3in screen into what would traditionally be a 11in laptop's chassis. With one of Intel's fifth-generation Core processors inside, you can also expect plenty of speed, and Dell claims a superb 15-hour battery life. It's available now with only one downside: the price, which starts at £1,099 inc VAT.



★ CES Top Pick

Lenovo LaVie Z

This laptop weighs 770g. Let's repeat that: 770g. Not a tablet, but a fully loaded Windows 8.1 PC with a lovely 13.3in screen, Core i5 processor and 128GB SSD. And it weighs 770g. We were lucky enough to have a play with one at CES (pcpro.link/246lavie) and the experience of picking it up for the first time was simply bizarre: it feels like you're holding an empty shell. The LaVie Z does have some drawbacks: with black, square lines, it's no beauty; battery life is limited to six hours; and it's only for sale in the US, for now. But if you find yourself Stateside from May, then you can pick one up for \$1,299 (around £854).

PC Probe

Fighting back: Microsoft's court battle

Microsoft has been found in contempt of court for refusing to hand over data held in Dublin. Is this an important privacy test case or a futile PR exercise? **Nicole Kobie** investigates



■ Data fallout

Microsoft's legal counsel Brad Smith has said that if the company loses the case, cloud companies will have to consider encrypting data without holding the keys, or store data with firms abroad that have no US ties, to avoid government meddling.

Caspar Bowden, who held the post of Microsoft's chief privacy advisor until 2011, disagreed that the case might have such far-reaching consequences. "The impact will be cosmetic," he told *PC Pro*. "The risk of NSA surveillance is unaffected."

Bowden has publicly stated that he hopes Microsoft loses the case because a win will make it seem as though the current system works. "If Microsoft wins, then the entire EU data-protection establishment breathes a sigh of relief; the [European] Commission can convince itself that a new Safe Harbour and Umbrella Agreement is doable; the EU data-protection authorities can step back

from seeing the past 15 years' work on transfers crumble into the abyss," he said. "But then nothing will change: the rotten system of illusory protection against the NSA will stagger on."

Daniel Castro, a senior analyst with the Information Technology and Innovation Foundation, noted that there are other legal methods by which the US government could get its hands on that data. "In effect, it's asking the company to conduct an extraterritorial search and seizure – one that the US government itself could never do in Ireland," he told *PC Pro*. "However, the US government could alternatively obtain this information through the Mutual Legal Assistance Treaty (MLAT)." Using the MLAT process, the US government

could have subpoenaed this information from Ireland.

Microsoft has found supporters in rival tech firms, including Apple, Cisco and Verizon, as well as the Irish government, which echoes Microsoft's contention that the US should ask for the data via existing legal agreements.

Microsoft has spent more than a year battling the US administration in court over data held in Dublin – but does it matter if it wins or loses?

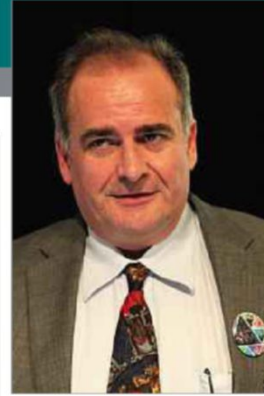
The case concerns emails and related data that US authorities are demanding from the firm – information that's held in its data centre in Dublin. Microsoft contends that such a demand is in violation of a safe-harbour agreement between Europe and America, and has therefore refused to play ball – falling into contempt of a US court.

The data includes all emails stored and sent from a particular account, profile details, records of session times, the IP address used to register it and to log in, plus methods of accessing the account. The data is being sought as part of a probe into drug trafficking and money laundering.

"The government cannot seek and a court cannot issue a warrant allowing federal agents to break down the doors of Microsoft's Dublin facility," Microsoft said in a court filing. "Likewise, the government cannot conscript Microsoft to do what it has no authority itself to do – [in other words] execute a warranted search abroad."

The American government disagrees, with one of the judges saying: "It is a question of control, not a question of the location of that information."

“ If Microsoft wins, nothing will change: the rotten system of illusory protection against the NSA will stagger on ”



LEFT Former employee Caspar Bowden has declared that he'd be happy to see Microsoft lose this battle

Data sharing after Snowden

Although Microsoft is voicing concerns that a loss in this case would result in putting user data at risk, Bowden noted that prior to the Snowden leaks, the company had already handed over data to the US authorities, "perhaps without warrant".

"For years the company handed over metadata to law enforcement without following RIPA procedures for data obtained outside the UK," said Bowden. RIPA is the Regulation of Investigatory Powers Act, which is the UK law that covers the interception of communications.

Indeed, before Edward Snowden released details about the NSA surveillance programme, Microsoft made clear when it launched Office 365 that the US Patriot Act would let American authorities have access to EU-stored data. That was back in 2011. Two years later, following the Snowden leaks and on the day the warrant was filed, Microsoft's lawyer Brad Smith changed the tune: "We are committing contractually to not turning it over without litigating that issue."



TOP Microsoft is concerned about the growing mistrust that users feel towards big tech companies

BOTTOM The firm's lawyer, Brad Smith, states that the company has "contractually committed" to litigating the issue

Safe in the cloud?

Regardless of the outcome of this court case, it may well be wise for Microsoft to be seen to be fighting US data grabs. In 2013, Castro predicted that Snowden's revelations about the NSA's surveillance and IT firms' apparent complicity would knock \$35 billion in revenue from the US cloud industry. Has this been the case?

"Most of these companies don't report such sales data at a detailed level," Castro said. "That said, we're certainly

seeing evidence that US companies have been cut out of some deals because of fears about US surveillance. The CEOs of both Qualcomm and Cisco have stated that the fallout from the spying scandal has cost them business in China."

Microsoft made a similar claim. "Over the past year, Microsoft and other US technology companies have faced growing mistrust and concern about their ability to protect the privacy of personal information located outside the United States," Microsoft said in court documents. "The government's position in this case further erodes that trust, and will ultimately erode the leadership of US technology companies in the global market."

"This case highlights that where data is stored may affect how easy it is for government to gain access to it. The tech industry needs to work to eliminate these differences, otherwise we're going to see countries beginning to erect data-residency requirements that limit where data can be stored." The upshot of this, according to Castro, will be an increase in costs for the users.

Bowden noted that Microsoft isn't alone in struggling to deal with American influence – potentially making European providers a wiser choice. "There's nothing a US-controlled company can do to credibly immunise itself from the taint of coercive measures by the US government against non-Americans," he said. To fight that, he called for US tech companies to lobby the government to stop "discrimination by nationality" – that is, to stop treating the data of Americans and "non-Americans" differently. He asked: "Would you get on a roller coaster that was built to 'good enough for non-American standards', if Americans were hopping on a different one with vastly higher safety standards that they thought necessary for themselves?"

Timeline of the case

APRIL 2014

A New York court finds that the warrant is valid, ruling that Microsoft must turn over the data. Microsoft still refuses.

SEPTEMBER 2014

Microsoft is found in contempt of court for its refusal to share the data – although the court reveals that the company and the US government have agreed there will be no fine or other punishment, in order to let it appeal.

DECEMBER 2013

US government serves Microsoft with a search warrant, demanding access to Outlook.com emails stored in Dublin for a drugs and money-laundering case. Microsoft hands over some metadata, but refuses to give the US authorities the full content of the emails.

JULY 2014

After an appeal, another judge orders Microsoft to hand over the data.

DECEMBER 2014

Microsoft files its arguments, and tech firms, rights groups, media organisations, academics and the Irish government file amicus "friend of the court" briefs in support of the firm. Oral arguments in the case are expected this spring.



The A-List

The ultimate guide to the very best products on the market today

LAPTOPS

Apple MacBook Pro 13in with Retina display Laptop, from £999

apple.com/uk

Gram for gram, the MacBook Pro 13in is a powerhouse of a laptop. An Intel Haswell CPU delivers strong performance and great battery life, the PCI Express SSD is lightning-quick, and the sumptuous Retina display is a pixel-perfect delight.

REVIEW: pcpro.link/almb13rd



ALTERNATIVES

Lenovo IdeaPad Yoga 2

A versatile hybrid laptop with the best IPS screen in its price range – now available at an irresistible price. **£400;** johnlewis.com **REVIEW:** pcpro.link/alyoga2

Dell XPS 12 (2013)

Sturdy build and a great all-round design make this an Ultrabook to lust after. The Full HD touchscreen is excellent, as is battery life. **£899;** dell.co.uk **REVIEW:** pcpro.link/alldell12

Asus X552CL

A capable 15.6in desktop replacement. Battery life is merely okay, but there's enough power here to get the job done. **£350;** saveonlaptops.co.uk **REVIEW:** pcpro.link/alx552cl

SMARTPHONES

Sony Xperia Z3 Compact Android smartphone, 16GB, free phone, £23/mth, 24mths

omio.com

The 4.6in Xperia Z3 Compact is alluringly pocketable, yet combines speedy performance with decent battery life and a fine camera. The rugged, water-resistant design is a plus point, too – and all for a very reasonable price.

REVIEW: pcpro.link/alsonyz3



ALTERNATIVES

Motorola Moto G (2nd Gen.)

An Android bargain with a 5in screen, good battery life and a superb design. **Free phone, £19/mth, 24mths;** omio.com **REVIEW:** pcpro.link/almotog2

Samsung Galaxy S5

A fast, weather-resistant, feature-packed phone. The camera is fantastic, too. **Free phone, £23/mth, 24mths;** omio.com **REVIEW:** pcpro.link/algals5

Apple iPhone 6

Apple steps up to a larger screen size with the classy, long-lasting 4.7in iPhone – but it's pricey. **Free phone, £35/mth, 24mths;** omio.com **REVIEW:** pcpro.link/alip6

TABLETS

Apple iPad Air 2 9.7in tablet, 64GB, £479

apple.com/uk

Even faster, even lighter and just as pretty as ever – the iPad Air 2 takes everything that made the original great and improves on it. Updated cameras and the arrival of Touch ID are welcome upgrades, too. Its only real rival is the original 32GB iPad Air, now discounted to a tempting £359.

REVIEW: pcpro.link/alipair



ALTERNATIVES

Nexus 7

Great design, solid all-round performance and keen pricing help the Nexus 7 retain its place on the A-List. **16GB, £182;** ebuyer.com **REVIEW:** pcpro.link/aln72013

Apple iPad mini 2

The arrival of the iPad mini 3 has pushed down the price of the mini 2, making it a steal. **32GB, £279;** apple.com/uk **REVIEW:** pcpro.link/alipmini2

Sony Xperia Z2 Tablet

The most desirable full-sized Android tablet yet, thanks to great design and battery life. **16GB, £350;** pcworld.co.uk **REVIEW:** pcpro.link/alxz2tab

PCs

Chillblast Fusion Quasar Base unit, £600

chillblast.com

Chillblast's Fusion Quasar is the very definition of a classy all-round base unit. A Core i5 CPU overclocked to 4.3GHz delivers plenty of raw power, combined with good gaming capability and serious upgrade potential. A five-year warranty seals the deal.

REVIEW: pcpro.link/alchill



ALTERNATIVES

Apple iMac 21.5in

A classy all-in-one with a compact frame, ample power and a colour-accurate screen. **From £899;** apple.com/uk **REVIEW:** pcpro.link/alimac215

Apple iMac 27in with Retina 5K display

Astonishing image quality and stunning resolution go hand in hand. **£1,999;** apple.com/uk **REVIEW:** pcpro.link/alimac27

Scan 3XS GW-HT20

The fastest workstation we've seen, thanks to the Haswell-E Core i7-5960X CPU. **£2,840;** scan.co.uk **REVIEW:** pcpro.link/algwht20

HALF-PRICE READER OFFER



KASPERSKY INTERNET SECURITY 2015 Buy 1yr protection, 3 devices, for £24.99 (RRP £49.99) Visit store.pcpro.co.uk

MONITORS

Asus PB287Q

Premium monitor, £450
overclockers.co.uk

Not so long ago, a 4K display for less than £500 was unthinkable. Asus delivers razor-sharp pictures on a generous 28in panel without breaking the bank.
REVIEW: pcpro.link/alpb287q



Eizo ColorEdge CS240

Eizo ticks almost every box with the 24.1in, 1,920 x 1,200 ColorEdge CS240. With a highly colour-accurate IPS screen, it's the first truly professional-class monitor we've seen at anywhere near this price. £545; native.digital.com
REVIEW: pcpro.link/alcs240

AOC q2770Pqu

A feature-packed, 27in, 2,560 x 1,440 display offering a huge workspace, an adjustable stand, a four-port USB hub – and a three-year warranty. Super PLS technology gives great viewing angles too. At this price, it's a steal. £360; dabs.com
REVIEW: pcpro.link/alq2770

PRINTERS

Canon Pixma MG6450

All-in-one inkjet printer, £80
currys.co.uk

The MG6450 inherits its predecessor's status as PC Pro's favourite inkjet all-in-one, offering high-quality output at a very reasonable price.
REVIEW: pcpro.link/almg6450



Canon Pixma Pro-100

Canon's professional-level inkjet printer is just the thing if you want prints that are a cut above the average. Produces sumptuous photographs at up to A3+ size, and its black-and-white output is stunning. £364; jessops.com
REVIEW: pcpro.link/alpixmappro

Epson Expression Photo XP-950

Epson's high-end inkjet all-in-one is a fantastic all-rounder for the enthusiast photographer. It combines high-quality prints with a decent scanner, a great touch interface and the ability to output photos at up to A3 in size. £250; pcworld.co.uk
REVIEW: pcpro.link/alxp950

ROUTERS

Netgear R7000 Nighthawk AC1900

802.11ac cable router, £145
broadbandbuyer.co.uk

A superfast router over 802.11ac, and speeds hold up well even at long range. With bundled backup software and fast USB 3 sharing ports, it's the ultimate Wi-Fi router.
REVIEW: pcpro.link/alr7000



D-Link DIR-868L

This 802.11ac wireless router may not have the most impressive set of features, and it lacks an internal modem. In our tests, however, it outpaced routers costing twice as much, making it an affordable way to get speedy wireless performance. £96; broadbandbuyer.co.uk
REVIEW: pcpro.link/aldir868l

Asus RT-AC68U

Hardly a value option, but Asus' flagship router offers 3x3 wireless, four wired Gigabit Ethernet ports and a pair of integrated USB sockets for high-speed file sharing. Cloud-based access and synchronisation tools are a bonus. £176; broadbandbuyer.com
REVIEW: pcpro.link/alac68u

HOME NETWORKING

Synology DiskStation DS214play

Network attached storage, £296
ebuyer.com

A hugely versatile NAS with built-in Wi-Fi and some of the best media-streaming and cloud features we've seen, as well as eSATA and USB extensibility. It packs a lot of power into a solid, compact unit.
REVIEW: pcpro.link/alds214play



Netgear ReadyNAS 314

This NAS drive isn't cheap, but it's fast, reliable and easy to use – while offering advanced features such as unlimited block-level snapshots and iSCSI thin provisioning. The best buy is the diskless model. £412; ebuyer.com
REVIEW: pcpro.link/alrnas314

Google Chromecast

This is the future of TV streaming – cheap to buy and simple to use. Plug the Chromecast into a spare HDMI port at the back of your TV, then browse on your smartphone or tablet and beam Full HD content directly onto the big screen. £30; play.google.com
REVIEW: pcpro.link/alccast

WEARABLES

Pebble Steel

Smartwatch, £180
firebox.com

The Pebble Steel isn't the flashiest smartwatch out there, but it offers great battery life, brilliant apps and a simple interface with solid physical controls. Plus, it supports both iOS and Android.
REVIEW: pcpro.link/alpebsteel



LG G Watch R

Android Wear smartwatches don't tend to have great battery life, but the G Watch R is the best we've seen. With an attractive, round-faced design, a punchy and colourful display and a heart-rate monitor, it's the best Android smartwatch so far. £201; amazon.co.uk
REVIEW: pcpro.link/algwatchr

Motorola Moto 360

Functionally, there isn't much to choose between the various Android Wear contenders, but Motorola's tasteful, circular-faced smartwatch is a winner in the style stakes. Qi wireless charging and a built-in heart monitor are welcome additions, too. £199; johnlewis.com
REVIEW: pcpro.link/almoto360

SECURITY SOFTWARE

Kaspersky Internet Security 2015

NEW ENTRY

Another year, another excellent performance. It's super-secure, lightweight and unintrusive.

3 devices/1yr, £20; ebuyer.com

REVIEW: see p88



Avast Free Antivirus

NEW ENTRY

Still the best free antivirus, although others are catching up. It offers dependable protection – and it doesn't nag you about upgrading. Free;

avast.com

REVIEW: see p89

Norton Security 2015

NEW ENTRY

It isn't the cheapest, but the protection provided is good and it covers up to five devices, from laptops to tablets and smartphones.

5 devices/1yr, £37;

amazon.co.uk

REVIEW: see p93

PRODUCTIVITY SOFTWARE

Microsoft Office 2013

Microsoft retains the top spot for the ultimate office suite, although tablet users may be disappointed by lacklustre touch support.

From £110; office.microsoft.com

REVIEW: pcpro.link/aloffice13



LibreOffice 4

The UI looks a little dated, and Microsoft Office has the edge on features. All the same, LibreOffice is an impressively powerful office suite – and it won't cost you a penny.

Free; libreoffice.org

REVIEW: pcpro.link/allibreoffice

Scrivener

A brilliant package for serious writers: not just a word processor, but a tool that helps you organise your ideas and manage the process of composition from start to finish. £28;

literatureandlatte.com

REVIEW: pcpro.link/alscrivener

CREATIVITY SOFTWARE

Adobe Creative Cloud

The licensing model won't suit everyone, but Adobe's suite of creative tools is second to none, covering everything from photo and video editing to web development.

Complete plan, £46/mth; adobe.com

REVIEW: pcpro.link/alcccloud14



Adobe Photoshop Elements 13

Adobe's home image-editing tool is a terrific and powerful buy, although users of older versions won't find much reason to upgrade.

£50; amazon.co.uk

REVIEW: pcpro.link/alelements13

Steinberg Cubase Pro 8

A big bump in performance and a handful of UI improvements keep Cubase at the top of the audio-production tree. A worthwhile upgrade.

£448; steinberg.net

REVIEW: pcpro.link/alcubasepro8

SERVERS

Boston Value Series 361 G8

Massive compute density, courtesy of a whopping 40 Intel Xeon CPU cores, combines with high-end storage features, 10GbE and integral battery backup units. It adds up to the best 1U rack server money can buy. £5,899 exc VAT;

boston.co.uk

REVIEW: pcpro.link/al361g8



HP ProLiant MicroServer Gen8

A space-saving microserver with excellent remote-management features that's perfect for even the smallest of businesses – and it's reasonably priced, too. £370 exc VAT;

ebuyer.com

REVIEW: pcpro.link/alhpgen8

STORAGE APPLIANCES

Qnap TS-EC880 Pro

Qnap's eight-bay desktop NAS sets new standards in the desktop NAS appliance space, combining ultra-powerful hardware with every storage feature you could wish for. It has huge expansion potential, and 10GbE networking seals the deal. Diskless, £1,144

exc VAT; dabs.com

REVIEW: pcpro.link/alec880pro



Synology RackStation RS2414RP+

Built with speed and expansion in mind, this 2U rack NAS offers a veritable feast of storage features and plenty of expansion potential. It's good value, too.

Diskless, £1,362 exc VAT; ballicom.co.uk

REVIEW: pcpro.link/alrs2414rp

SECURITY

WatchGuard Firebox T10-W

Packed with wired and wireless security features, the T10-W includes IPS, web-content filtering, application controls and HTTPS inspection. The box acts as a dual-band wireless AP, too. There's nothing better at this price. £510 exc VAT;

watchguard.com

REVIEW: pcpro.link/alfireboxt10w



Sophos Cloud

User-based policies and slick mobile support make this a top-class cloud solution. Performance is impressive, too. It's not the cheapest option, but it's a pleasure to use. 10 users, £510/yr exc VAT;

sophos.com

REVIEW: pcpro.link/alscloud

BUSINESS PRINTERS

Epson WorkForce Pro WF-5620DWF

NEW ENTRY

Shatters the myth that inkjets are only for low-demand use, delivering fast output speeds, low running costs and tons of features.

It prints at 20 pages per minute, and quality is perfectly acceptable – it can even print glossy photos. £235 exc VAT;

printerland.co.uk

REVIEW: see p99



HP Officejet Pro 8620

NEW ENTRY

A top-class business inkjet all-in-one with low running costs and top-quality colour output. Not the fastest, but it packs in the features. £136 exc VAT;

misco.co.uk

REVIEW: see p100

BACKUP

Barracuda Backup Server 290

A beautifully simple appliance that brings together on-site and cloud backup. There's block-level deduplication, extensive support for Windows systems and applications, integral Exchange MLB and simple deployment and management.

£4,446 exc VAT; barracuda.com

REVIEW: pcpro.link/alserver290



MozyPro

An affordable cloud backup service for desktops and servers that sets the standard for deployment and management. It will handle parallel local backups for faster restores. 50GB/1yr, £154 exc VAT;

mozy.com

REVIEW: pcpro.link/almozypro

NETWORK MANAGEMENT

NetSupport Manager 12

Release 12 of this indispensable support tool brings a new PIN Connect feature for instant connections and a redesigned console that makes it easy to manage a large number of PCs. Android and iOS are supported via apps, and the price is a one-off fee rather than a subscription, so it's superb value.

250 seats, £28 per seat exc VAT;

netsupportsoftware.com

REVIEW: pcpro.link/alnetsupport



Paessler PRTG Network Monitor 12.4

Licensed by the number of sensors, and with a proprietary database included, PRTG is a great-value auditing and monitoring tool with no hidden costs.

500 sensors, £1,077 exc VAT; paessler.com

REVIEW: pcpro.link/alprtg124



Experience everything UltraClear

Reveal the finest details with the UltraClear 4K UHD monitors

With 3840 x 2160 resolution, UltraClear HD delivers four times the precision of Full HD. This monitor offers the ultimate combination of size, picture clarity and performance. The 4K UltraClear UHD monitors are available in 28- and 40-inch screen sizes.



UltraClear 4K UHD

288P6LJEB

BDM4065UC

MISCO Systemax

ebuyer.com

BT Business Direct

PHILIPS



Profile

BACKGROUND INFO ON INNOVATIVE BRITISH COMPANIES

YouView

YouView is proving that a British technology firm is more than capable of matching the internationals when it comes to offering TV services – and the best is yet to come



KEY FACTS

YOUVIEW IN A NUTSHELL

YouView is a British TV service that combines digital terrestrial broadcasts with on-demand internet TV, including BBC iPlayer, ITV Player and 4oD. It's owned by a number of high-profile broadcasters and broadband providers, including the BBC, ITV, Channel 4, BT and TalkTalk.

LOCATION London

FOUNDED 2008

EMPLOYEES 170

WEBSITE
youview.com

If Microsoft's software engineers have to cross their fingers every time they send out one of their monthly patches, hoping that it doesn't brick millions of people's PCs, spare a thought for those who write software for the most important box in the house: the TV.

"People view television as something that should just work," Piers Lomax, head of engineering at digital TV firm YouView, told *PC Pro*. "The pressure to get it right every time is very high."

That's one reason why Lomax is rapidly expanding his team, boosting YouView's London-based engineering department from 100 people to 150 in the coming months. They'll be joining the fastest-growing TV platform in the country, which now boasts more than a million customers.

Those numbers mask the occasionally tortuous road YouView has travelled. Founded in 2008, it's been through several incarnations, including a turbulent few years under the leadership of Lord Sugar. However, it finally looks well placed to deliver the next generation of TV services – be they regular terrestrial broadcasts, video-on-demand or live streams – to millions of people.

■ Blank canvas

YouView started life as Project Canvas, a joint venture between the BBC, ITV and BT. Having failed to gain the Competition Commission's permission to launch a pure video-on-demand service dubbed Project Kangaroo, the broadcasters channelled their efforts into digital terrestrial TV with internet services.

Progress was always likely to be slow with three big corporations working together, and this was exacerbated when Channel 4, Five (now Channel 5) and TalkTalk joined the party in 2009, followed by transmitter operator Arqiva in 2010. The project was dogged by reports of delays and bickering over the software design, not to mention the various regulatory hoops through which it had to jump.

By 2011, with the YouView brand now in place, the partners decided they needed an individual to drive the project to completion. In stepped Lord Sugar, who brought his experience of the set-top-box market and no-nonsense attitude to the table. Sugar took the project by the scruff of the neck, and the first YouView box finally appeared in July 2012 – almost four years after Project Canvas was born.

Lomax insists it wasn't so much boardroom squabbles as getting the technology right that accounted for that time. The service combines more than 70 free-to-air live digital channels with on-demand shows from BBC iPlayer, ITV Player, 4oD and more.

YouView aims to make the join between terrestrial shows and internet TV as seamless as possible. It was the first TV service to offer a "seven-day-backwards programme guide", which allows viewers to hop back in the schedules and catch up on shows they've missed from the past week. "A lot of it hadn't been done before, certainly not in a way that made it easy to use," said Lomax when pushed on the four-year wait. "We've won many awards for the way we've simplified what is a potentially complex and hard-to-understand landscape. Certainly, when we launched, there was nothing like it."

Sugar left the company in 2013, after a trademark boardroom row with Channel 5's then-owner, Richard Desmond. But YouView has flourished without him: now bundled with BT and TalkTalk's broadband packages, YouView boxes sit beneath the TV in more than a million British homes.

■ Taking control

Lomax isn't planning on putting his feet up now that the service is established. Unlike chief rival Freeview, which is an open specification that TV and set-top-box manufacturers can build into their own firmware, the software for YouView boxes is written and controlled by YouView. This means Lomax and his team can continue to drive new features into the boxes, helping to distinguish the service from rivals that have been busy adding on-demand extras of their own in recent months.

"We can improve it ourselves; we don't have to wait for everyone to update their own version of the software," said Lomax. "Usually, we can push out updates across all devices in a short time frame. Having a single interface, without tweaks and customisations, avoids the fragmentation issues that can occur on other platforms."

The team is currently engaged in transitioning some of its on-demand services, such as BBC iPlayer, from Flash to HTML5, which Lomax claims will be a boon for all involved. For the BBC, it means it can easily adapt iPlayer's design to whatever device it's running on at the time, meaning the Beeb has fewer lines of code to manage.



ABOVE YouView will be expanding its 100-strong engineering team to 150 this year

ABOVE RIGHT The software integrates with third-party services such as Netflix and BBC iPlayer

RIGHT YouView was the first TV service to offer a seven-day-backwards programme guide



ABOVE YouView is now integrated into third-party devices such as Humax's

They're not testing only for glitches, but also for usability. "Our staff get involved in these trials, and we make sure BT and TalkTalk are happy with the software, and their customers are happy, before it's released to everyone. It goes through a number of different phases, which is typical for software of this complexity with this number of customers."

The testing team is only one that will benefit from



the influx of recruits that YouView hopes to attract in the next few months. There will be jobs available in the user-interface team, vacancies for HTML and JavaScript developers and more in the core device software team.

YouView is also looking to recruit a batch of interns for three- and 12-month placements that begin this summer, following the success of a similar scheme last year. The company promises that young workers will get the opportunity to work on "cutting-edge projects that make a real difference to the business, from product designs and code-writing to testing and project management, plus much more". Pushing the interns certainly reaps benefits: a third of the 2014 intake were offered a permanent position or continued work with the company.

■ Blending old and new

Lomax claims graduates are attracted to YouView because they're dealing with the "latest consumer technology", but, compared to cheaper rivals such as Sky's Now TV box or the Roku range, the company appears to be clinging to relatively old-fashioned digital TV tuners to deliver much of its content. Is an IP-only YouView box on the company's technology roadmap? "There are huge advantages to broadcasting programmes, even with increased interest in [the digital TV] spectrum for mobile use cases," said Lomax.

"It will be a very long time before we see pure IP plays, because there just isn't yet the coverage that can be offered via [terrestrial] broadcast. But this is changing over time, and faster connections will become the norm. We're making sure the set-top boxes have the facility to be able to receive channels in whatever is the appropriate means, and we're not making any statements about when one or the other will be phased out."

For YouView, it's in with the new and not quite out with the old. **BARRY COLLINS**

“ Having a single UI, without tweaks and customisations, avoids the fragmentation issues that occur on other platforms ”

■ Testing times

Of course, regularly pushing out new features entails risk, and customers are incredibly unforgiving if they can't wind down in front of the TV of an evening because a software update has crippled their set-top box. Lomax insists, therefore, that the company takes great care to ensure that such updates don't

result in blank screens. "We're heading rapidly towards two million customers, so releasing software is an incredibly important thing to get right," he said.

The company has an in-house team of testers, but it doesn't bank purely on human detection. "We rely a large amount on test-automation equipment to reduce the chance of any one feature causing problems," Lomax added.

"We test 24 hours a day, with boxes of all types. These tests allow us to catch problems well before releasing to customers. We then have a trial programme that allows a small number of customers, and then an increasingly larger number of customers, to use the software and provide feedback before it's released mainstream."

What about you?

Do you work for a British technology company that could be profiled in PC Pro? Then get in touch: profile@pcpro.co.uk



Viewpoints

PC Pro readers and experts give their views on the world of technology

Virtual reality is here to stay – so is actual reality on the way out?

After decades in the doldrums, VR is finally starting to show its world-changing potential



Darien Graham-Smith is PC Pro's deputy editor. Give him a VR edition of Super Mario 64 and you can keep the real world.

As I manoeuvred Samsung's new Gear VR headset over my spectacles, my expectations weren't high. I didn't see any reason why this latest implementation of "virtual reality" should succeed where countless antecedents had failed. Still, I pressed the button to wake it up, and the binocular

displays leapt into life. My colleagues at their neighbouring desks were naturally unable to see what I was experiencing – but anyone watching closely would have noticed my indulgent smirk turn rapidly into the hanging jaw of astonishment.

Inside, I was trying out my first virtual-reality app of the modern era, an odd creation called The Blu VR. On paper, it's an unambitious concept: you're an underwater observer, drifting around the ocean as fish and other marine creatures swim by. You have no control over your movements; you're just there to watch. Apparently there's a soundtrack too, but Jon, our reviews editor, hadn't given me any headphones.

It didn't matter. Although the resolution of the image wasn't particularly sharp, and even with the noise of a busy publisher's

office clattering in my ears, I found myself – if you'll pardon the expression – utterly immersed. As a school of digital angel fish glided past me, I felt, on a visceral level, the exhilarating isolation of the deep-sea diver. I'm here to tell you that virtual reality has finally arrived.

Needless to say, the technology that makes all this happen is sophisticated stuff: Paul Ockenden goes into more detail about it on p113, and you'll find Jonathan Bray's full review of the Gear VR on p68. From the user's perspective, however, the magic boils down to three ingredients. First, the image fills your entire field of vision, right out to the periphery. If, as a child, you ever stood in the huge 180-degree surround-cinema tent at Thorpe Park, you'll know how powerful this alone can be. The roller-coaster footage knocked me off balance every time.

The Gear VR also delivers true stereoscopic 3D. Even through my glasses, the effect was remarkably realistic. Actually, "remarkably" is precisely the wrong word: the 3D was so natural that I had to experimentally close one eye a few times to assure myself that I wasn't simply imagining it. Persuasive proof arrived when a shark came swimming straight towards me and I involuntarily jumped out of my seat.

“The Gear VR responds with accuracy; it makes you feel that you're not merely looking into a virtual world, but are within it”

But it's the third stool-leg, as it were, that makes the Gear VR a revelation. Back in 1968, Ivan Sutherland's original "Sword of Damocles" VR display used a head-tracking system to allow the user to "look around" the virtual world – but with its industrial-scale mechanical mounting, the experience was basically like peering through a periscope.

The Gear VR, by contrast, is a lightweight, standalone headset that gives you complete freedom of movement. You can tip your head back to look up; swivel in your chair to see what's behind you; and glance nervously about as a blue whale passes close by. It responds with accuracy to both deliberate inputs and instinctive movements. It makes you feel that you're not merely looking into a virtual world, but are actually within it.

So, the question arises: will I be rushing out to buy my own Gear VR headset? Honestly, I came away tempted, even though the £190 price doesn't include the cost of the Galaxy Note 4 smartphone you'll need to drive the thing.

What cooled my ardour was the realisation of what would happen once I got the unit home. I saw myself bursting through the front room crying "look at this!" to my wife. We'd tear the headset out of its box, and excitedly set it up. And then one of us would put it on, and the other would be left sitting on the sofa, twiddling his or her thumbs.

This, for me, is the key limitation of VR. The entertainment experiences on offer are crying out to be shared, but the headset inevitably isolates the user from friends and colleagues. The effect is neatly illustrated by the Oculus VR Cinema app, which comes with the Gear VR headset. It's a fun idea that lets you enjoy movies in the comfort of your own virtual cinema – but look around and you'll see that you're surrounded by empty seats. The symbolism is hard to miss.

Of course, this is a surmountable problem. No doubt, clever people are already building Second Life-type frameworks that will enable us to commune in virtual spaces with friends both local and remote.

What I'm not so certain of is whether this is actually a good thing. If VR can transport us to incredible places at the click of a button – and I've seen with my own eyes that it can – then what does that do to our relationship with the real world? Why commute to work when you can attend that important meeting in your pyjamas? Why go to the pub when you can meet your friends in a virtual speakeasy that never closes? Why travel at all, when all the world's sights and landmarks are just a tap and a swipe away?

Given how readily we've accepted computerisation into every other aspect of our lives, I suspect we may be witnessing the emergence of a tremendously disruptive technology – and I don't mean disruptive like a smartphone app, but disruptive like a nuclear bomb.

So while I can't wait to see how it develops, I'm reminded of Timothy Leary's identification of cyberspace as a modern analogue to 1960s counterculture: once it becomes possible to socially inhabit the virtual world, I don't doubt that many of us will indeed turn on, tune in and drop out.

darien@pcpro.co.uk

The cars we drive are in need of a tech boost

There's plenty of tech that could be integrated into cars, so why isn't the motor industry forging ahead?



Jonathan Bray is PC Pro's reviews editor. The in-car tech he's really waiting for is a mute button for his kids sitting in the back seat.

I'm more than a touch peeved that Darien stole my thunder this month, by writing about VR in his column. The Samsung Gear VR is the most interesting piece of hardware I've seen for an age; it's technology that demands to be written about, discussed and debated, so you'll

forgive me if my new topic doesn't quite match up when it comes to excitement and intrigue.

However, this subject is one that's close to my heart. It's car tech or, more specifically, in-vehicle communications and entertainment systems (dubbed by some as infotainment systems). And I'm sad to say this is not one of those positive columns; I'm here to have a moan.

A moan about how far behind the motor industry lags when it comes to the tech available in everyday cars - and I'm not talking here about top-end models such as Audi, Mercedes or Lexus, but the sort of family runabout of which I've just taken delivery. Standard equipment is still embarrassingly antediluvian.

Don't get me wrong, the situation isn't quite as parlous as it was ten or so years ago. I once remember seeing a full-page advert for a popular small car in *The Guardian*, which chose to promote as a major feature the fact that it had a 3.5mm audio auxiliary input. At the time I was agog; I still am today.

Fortunately, car manufacturers have overcome that particular speed bump. My new car - a shiny blue Hyundai i40 Tourer - has a stereo that complements its aux input with a USB port and Bluetooth, plus the ability to play MP3s and CDs, and connect an

iPhone or iPod. But it's still not ideal, and the system has major niggles: for example, you can only connect USB sticks formatted with the FAT32 file system, and only then those formatted with a sector size of 512KB or 2MB, and you can't use card readers or hard disks.

And while the Bluetooth audio connection works well when the phone is dealing with all audio, things get fiddly when you want to mix and match. Want to listen to AM or FM on the car stereo, with Google Maps intercepting turn-by-turn instructions via Bluetooth? You can't, because the software routes audio via Bluetooth media playback; the stereo only picks up on phone calls.

So what's the answer? Well what I want - as do, I suspect, the majority of smartphone-toting consumers - is proper smartphone integration. Almost everyone now has one of these compact computers in their pockets; almost everyone has music, satnav and the internet on tap, so why not take advantage of it? Why not make space in the dash for the phone, provide a convenient USB charging point and implement a flexible Bluetooth audio interface?

The bad news is that there's precious little to suggest that the car industry is actually taking note of these trends in consumer technology, with many still opting to make money from underpowered satnav upgrades.

The good news is that there is a light at the end of the Mont Blanc Tunnel, and it comes in the form of rival in-car systems from Apple and Google, namely CarPlay and Android Auto. While neither system employs the smartphone as the main control surface, both make use of its capabilities to "stream" the apps installed therein to the car's comparatively dumb touchscreen.

A significant part of both systems is that voice recognition is set to provide comprehensive hands-free control and input. In the case of CarPlay it's Siri, and for Android Auto, Google Now takes the reins.

From personal experience of using touchscreen entertainment and satnav systems in the car, I'd suggest this latter feature is likely to be the most significant step forward: speech input allows drivers to keep their hands on the wheel and yet remain fully in control of audio, messaging, phone calls and navigation. Scrolling, swiping and entering text manually to search are hugely distracting and dangerous. With Siri and Google Now both wired into activation buttons on car steering wheels, operating them should be considerably safer than most current systems.

You may notice that I've used the future tense here to describe the systems. That's because, despite the fact that both CarPlay and Android Auto are available to car manufacturers, few have added either system to their current car ranges, even though many have announced support for them. And those that have are rather exclusive - Ferrari's FF was the first to deliver CarPlay to drivers

in September last year. As usual, the car industry is taking its time.

For the rest of us, then, the brave new world of ubiquitous in-car smartphone integration still looks to be a long way off. Maybe next time I change the car it will be a different story; past experience, however, suggests that I'm likely to be disappointed.

jon@pcpro.co.uk

Smart devices are stupid without better security

Tech firms showed off the wrong sort of innovation at this year's Consumer Electronics Show



Nicole Kobie is Briefing and Futures editor. She's looking forward to ignoring updates on her watch as well as her PC.

Tech firms have a vision of how we'll live in the near future - and what we'll buy from them to make it happen. If the products on show at CES in Las Vegas at the beginning of January (see p14) are any indication, within the next year or so, we'll have smartwatches on our wrists, fridges

that restock themselves, TVs that know what we want to watch, and heating systems in our homes that are aware of how warm we like it.

To make this exciting world of the future happen, manufacturers and their engineering geniuses have innovated in numerous areas, reimagining everything from batteries to data analytics, and all at prices that we can actually afford. What they haven't done, however, is to address the problems that exist in the technology we already have, notably privacy and security.

Take smartphones as an example. They've undoubtedly changed how we go about our lives, but they also give governments (and anyone else with the power or inclination) the ability to track exactly where we are and to whom we're speaking. If you doubt the seriousness of this, consider the fact that the US military uses mobile metadata to target its drones. This information is powerful.

We all know this is happening. What's the response from the tech industry? Rather than invest in securing smartphones, manufacturers are spending their R&D budgets on developing new gadgets, with

“The bad news is that much of the car industry is still opting to make money from under-powered satnav upgrades”

engineers making decisions over whether a watch's face will be round or square. And how do we respond? We shell out money to strap an even better spy onto our wrists.

Making a smartwatch or any other connected device that works well requires a host of clever innovations: simplifying the OS; redesigning notifications and navigation; extending battery life in smaller formats; new intelligent sensors; and ever smaller but more powerful chips. If manufacturers put as much effort into privacy and security, we'd be leaps and bounds ahead of where we are now. Instead, we have plenty of good-looking, functionally capable but deeply flawed products. It's time to slow the pace of innovation and take the time to do it right.

This isn't the first time we've leapt forward with a technology without really acknowledging existing problems. Consider the internet: it's difficult to imagine a technology that's had such a far-reaching impact on our lives. The internet and the web layered on top of it are such a brilliant combination that we've shifted much of our lives online: our work, our shopping, our bank accounts, our music and more.

That shift continues unabated, despite repeated hacks showing that none of what we put online is secure. Last year's Shellshock and Heartbleed flaws highlighted that much of the software infrastructure we depend on is full of long-running bugs. Clearly we're not safe online, yet for convenience we push more and more of our lives out there. The advent of smartphones was an opportunity to demand better security – building in encryption, for example – but the tech industry missed the opportunity to do so.

Now manufacturers want to add appliances, cars and many other products to the mix. We clearly don't learn our lessons. These days, we hope that our bank, shopping and email accounts aren't hacked, and rush to update passwords when attacks are reported. In a few years' time, we'll have the same response to attacks on our fridges, the heating systems in our homes and our cars too.

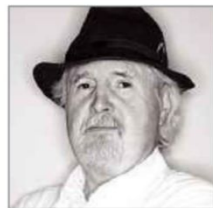
But would you buy a car where the manufacturer hadn't bothered to test the brakes properly? Then why buy a smart car where the manufacturer hasn't properly addressed digital security? You simply shouldn't.

CES will continue to be an annual showcase for new but flawed tech – unless we stop buying it. It's time to demand innovation in the areas that really matter.

 nicole@pcpro.co.uk

Image editing can transform a photograph – for good and ill

New technology in the fine-art world could help to search out child-abuse images online



Dick Pountain edits Real World Computing. He thinks it would be great if people came equipped with blend modes.

For several years, my major digital pastime has been photography. I joined Flickr eight years ago, and have now posted more than 1,500 pictures there (you can find them at [pcpro.link/246dpflickr](https://www.flickr.com/photos/246dpflickr/)).

During this time, the digital imaging market has been through a technical revolution, and now faces what tech gurus love to call "disruption". A generation now prefers to use a smartphone to take pictures, rather than a proper camera – and the quality of the results has improved extraordinarily, thanks to sensors and image processors from real camera manufacturers such as Sony.

Camera makers meanwhile are striking back with retro designs that recall the golden age of the Leica, with premium £1,000-plus prices aimed at separating "real photographers" from selfie-snappers.

As for me, I've resisted both trends. I started out posting mostly travel pics, street

My modus operandi is as eccentric as my choice of platform. I perform sequences of operations on picture, duplicating and saving layers, tinting, filtering and blending them in different modes – and rather than writing down this sequence so I can repeat it, I deliberately don't note a thing. I merely observe the changing image until I like it well enough to stop. I can never repeat exactly that effect again, which I'm convinced makes it "art" rather than mere processing.

Doing this so many times has given me a deep grasp of how pictures are made up, and about manipulating levels of detail and tonality. One of my favourite tools is the High Pass filter, which can separate levels of detail so that you can enhance or remove just that level. Another favourite trick is mixing some percentage of an outrageously processed image back into the original, to temper the effect and make it more subtle.

With this experience of the internal make-up of digital pictures, I was interested to hear about a new project by GCHQ and the National Crime Agency (NCA), announced in December 2014, which aims to deploy new algorithms for identifying online pictures of child abuse. According to the press release, these algorithms are "hash-based", which means they reduce the bit stream of an image to a single number that acts as its "fingerprint". Such fingerprinting is essential for evidence to be acceptable legally: it's necessary to prove that a picture confiscated from some offender is the same as one obtained from someone else. Obviously filenames and other metadata are of no use, since they're only loosely attached properties that can be easily changed.

According to the US website Federal Evidence Review, however, the hashing system widely used for this purpose is SHA-1: an algorithm designed for use on alphanumeric data, such as texts, passwords and gun serial numbers. It

won't generate matching hashes from bitmapped images whose contrast, saturation, sharpness and so on has been altered, either deliberately, or by accident.

The answer is content analysis – not merely hashing the bits – to electronically establish the identity of two versions of any bitmapped image. Face

recognition is well advanced nowadays, and so is the dissection of bitmaps into separate objects. So, although challenging, it may be possible to create a unique hash from the collection of persons, furniture and stuff isolated from each image.

Oddly enough, the required expertise is currently most advanced in the field of fine art rather than criminology: Iconclass (iconclass.nl) is a hierarchical notation system developed by Dutch painting scholars for cataloguing unique configurations of picture elements. All we need is something similar for far less salubrious subject matter.

 dick@dickpountain.co.uk

“Content analysis, not merely hashing the bits, is needed to establish the identity of two versions of a bitmapped image”

photos and landscapes. In recent years, I've become more interested in post-processing images to make them like paintings. There are plenty of software tools now available to spice up photos, and some, such as Google's Nik Collection of filters for Photoshop and Lightroom, are very good. But I'm less interested in buffing up my pictures than in dismantling and reconstructing them, and for this my chosen tool is Photoshop Elements 5. This ancient release lacks all the smart cut-out features of later versions, and many of the abilities of full Photoshop, but it has all I want: layers, blend modes and a handful of filters.

INTRODUCING ECOTANK

Save up to 65% on your printing costs*



Say goodbye to cartridges

Enjoy ultra low printing costs with our ingenious new printers. EcoTank printers come complete with a two-year supply of ink*. This allows you to print up to 4,000 pages in black or 6,500 pages in colour, without having to buy or replace a single cartridge*.

Available in store or online at Currys PC World.

Currys  PC World



* www.epson.co.uk/ecotank



EPSON®
EXCEED YOUR VISION



Readers' comments

Your views and feedback from email and the web

Filling the broadband gaps

I'm pleased to see in last month's Briefing (see issue 245, p10) that Ofcom has recognised that a 2Mbps/sec downstream speed isn't enough for a minimum broadband standard. But I note that upload speed gets no mention at all. Many small businesses need a fast uplink: your download is someone else's upload.

And for those who can't currently get 2Mbps/sec, surely the only sensible upgrade is to at least 30Mbps/sec? Otherwise, those locations will shortly have to be revisited at yet more cost. And why not use 4G as a fixed-premises link, charged at a landline rate, creating a more cost-effective solution for filling in "not-spots"?

As for households not upgrading to the fastest speed available, a more attractive pricing model is needed. Why should they pay a high price for a service that will be used only occasionally? Why not offer a base-level service at a lower price, with the facility to speed up on demand for an additional charge – say, while making a video call, or streaming a show in high definition with surround sound? That way users and content providers can progressively make more use of the higher speeds. **Alan Wheatley**

An alternative to Access

Regarding Simon Jones' article on solving spreadsheet problems, I'm a little surprised he didn't include FileMaker in his database solutions. I use Access, but find it seriously limited since it can't be used – as I understand it – on Apple systems. In my view, this rules it out as an option, since developing a solution that won't work on an iPad, for example, is a non-starter. FileMaker works across PCs and Macs, which makes it a favourite over Access for the work I do. **Martin Stoneham**

Simon Jones replies: "I suggest people look at Access not because it's good, but because it's ubiquitous. You don't even need to own Access to run an Access database, since there's a free runtime version available for any Windows PC. The latest version of Access will also make web apps that run in the browser, so these can be used from Mac and Linux desktops and from mobile devices. However, FileMaker has a long history as a cross-platform database application, and

Star letter

For many years, my advice to online buyers has been to purchase with a credit card. This way, if something goes wrong you have someone on your side who has a legal imperative to refund your money, even if the original vendor disappears.

Now PayPal and Apple are marketing themselves as ubiquitous payment systems for purchases. You can buy anything from anyone, even from physical vendors, using such services – but they aren't covered by the Consumer Credit Act. Although PayPal highlights its "Buyer Protection", my experience is that, unless the details of the

transaction and the procedure you followed fall within its defined small print, you won't be covered. With credit card transactions, the Consumer Credit Act provides consumer protection first and foremost, with no burden on the consumer to meet any arbitrary requirements.

Will Apple's new payment-processing system be any more effective in protecting consumers? Until the legislators catch up, people need to be made aware of just what they're giving away by clicking that seemingly inconsequential option of paying by PayPal! **Alan Ingram**

This month's star letter wins a Corsair Force Series LS 120GB SSD worth £75. Visit corsair.com



although it isn't cheap, it's well appointed with features. I'd agree that anyone considering creating a small database application should consider FileMaker."

Sexism in PC Pro

In your feature on sexism in tech (see issue 245, p56), Stewart Mitchell rightly noted the patronising tone of a developer who compared Apache Maven software to his girlfriend, declaring "the software looks beautiful, complains a lot, demands attention, interrupts me when I'm working and doesn't play well with my other friends".

Four pages later, in "10 inventions nobody wants", Stuart Turton wrote: "Artificial intelligence will either mirror the mind of its creator, or surpass it so completely we'll have no idea how to control it. I call this the girlfriend protocol, and it's frightening."

Full marks to Stewart, no marks to Stuart and none to Tim Danton

either – you should have spotted this one, Tim! **Peter Clegg**

Editor-in-chief Tim Danton replies: "It's a fair cop. I'd love to say we did this deliberately, to check whether people were reading the whole of the magazine or not, but that isn't true – we'll keep a closer eye on our own sexism in the future. Thanks to everyone who wrote in and pointed this out."

Smart desk is smart tech

What an interesting insight you gave into the future of the workspace with the HP Sprout and Dell smart desk (see issue 244, p127). My money's on the smart desk: the idea of a horizontal touchscreen tablet in conjunction with a hi-res monitor really appeals to me. It opens up a wealth of things you could do – not only typing, pointing and swiping, but drawing, writing and manipulating objects in a digital space, just as you might in the real world.

But the Sprout? Nah. The 3D-camera interface will go the

same way as 3D TV. Mind you, if you'd suggested five years ago that I might be typing this email from a touchscreen on my phone in bed, I'd have dismissed that, too! **Tom Allen-Stevens**

A future without work – almost

I read Darien Graham-Smith's most recent column with interest (see issue 245, p24). In an ideal world, I picture that we'd have 100% automation and 90%

BELOW Sexism isn't the preserve of the building site



unemployment – the 10% being shared jobs performed by all in the society to monitor, maintain and repair the machinery.

However, I don't think we'll reach the ideal. Instead, we'll reach a point where 75% of people are free to pursue a life of leisure, while the other 25% do most of the work in return for a reward. Not money, but perhaps a bigger house or some other material luxury.

I think the majority of people will accept the deal if they have a modest home and three meals a day, and never have to work. I see this transition taking place over 500, maybe even 1,000 years – and we are only 50 or so years into that journey. **Mosh Jahan**

The case of the lost product key

I purchased an Advent desktop computer from PC World a few years ago. Recently it stopped working, so I sourced a new motherboard, installed it and great – it worked again. At the same time, I decided to start from scratch and reinstall Windows 8 from the provided image, and this also worked fine.

However, Windows demanded reactivating, and that's where things

“Microsoft may never see me again, and I won't be buying another computer from Advent any time soon either”

took a turn for the worse. I knew a motherboard change would upset Windows, and had been told a phone call to Microsoft would sort out the issue. But when I spoke to Microsoft, they asked for my Windows product key. I looked on the case for the familiar sticker, but it wasn't there. I rang Advent and was told that my product key had been embedded into my old motherboard. “Tell Microsoft it's a repair,” was the advice.

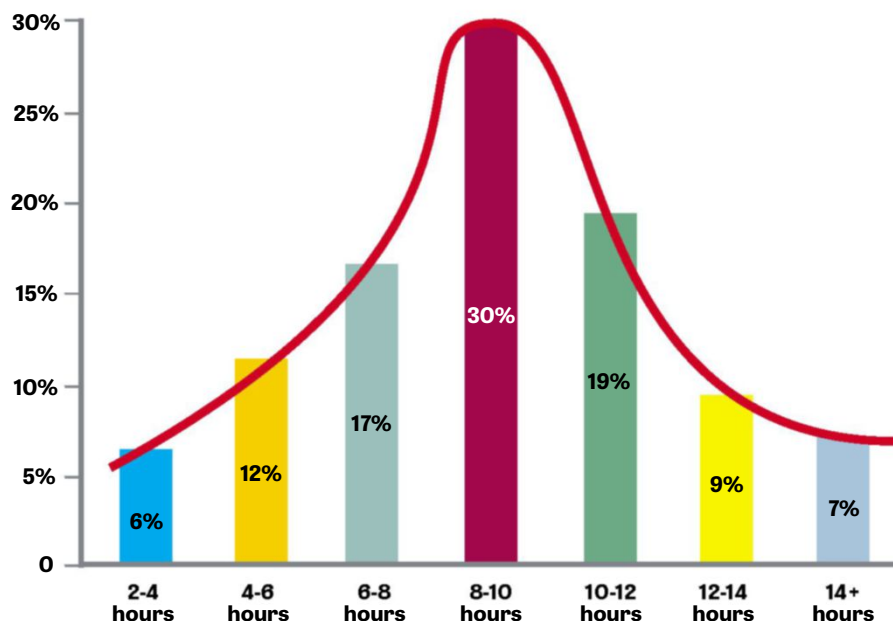
So I rang Microsoft again: they insisted I needed my product key. I rang Advent again: they said they had no way of knowing what it had been. Both of them now suggest I purchase a new copy of Windows 8. Thanks a lot.

So a word of advice – if you don't know what your Windows product key is, I'd strongly advise writing it down somewhere. As for me, I'm off to download Ubuntu. Microsoft may never see me again, and I won't be buying another computer from Advent any time soon. **Paul Crossley**

See our feature on p60 for advice on this and other Windows annoyances.

Readers' poll

On a work day, how many hours do you spend looking at a PC screen?



There's no strict medical definition of “too much” screen time, but staring at a digital display for hours on end can cause eye strain, and it's been associated with depression and sleep disorders too. Employers are legally required to ensure workers take regular breaks away from their PCs, but in reality, few of us do so, either at work or at home. As this month's poll shows, many *PC Pro* readers spend the majority of their waking lives looking at their laptop, smartphone or tablet.

“The amount of time I spend looking at my iPad at home is unnecessary”

“My previous job involved screen time, but breaks too. I'm staring at a screen all day now, and my eyes notice the difference”

“I spend nine hours at work looking at a screen – then head home and watch a movie on my monitor while freelancing”

“I was recently diagnosed as needing glasses. It might be my age, or it might be the PC, laptop, tablet, phone, smartwatch and Kindle!”



Join the debate



Join the growing *PC Pro* community on Facebook at facebook.com/pcpro



Get the latest news and updates by following us @[pcpro](https://twitter.com/pcpro)



Email us at letters@pcpro.co.uk



Add your comments to news, reviews and features at pcpro.co.uk

SUBSCRIBE

To subscribe to *PC Pro*, visit subscribe.pcpro.co.uk. For existing subscriber queries, contact pcpro@servicehelpline.co.uk, call 0845 126 0386 or visit subsinfo.co.uk



NEXT GENERATION 1&1 CLOUD SERVER

Easy to use – ready to go!

The new 1&1 Cloud Server offers all the advantages of dedicated hardware performance combined with the flexibility of the cloud!

FLEXIBLE & AFFORDABLE

Customised configuration

- SSD, RAM and CPU are all independently flexible, and can be adjusted exactly to your requirements

Transparent costs

- **NEW:** Billing by the minute
- **NEW:** The clearly-structured cost overview enables efficient planning and management

EASY & SECURE

1&1 Cloud Panel

- **NEW:** The innovative, user-friendly interface – with smart administration – simplifies the management of your server

Security

- The high-performance 1&1 Data Centres are among the safest in Europe
- Backups and snapshots prevent accidental data loss
- The integrated firewall protects your server from online threats

ALL-INCLUSIVE

Top performance

- **NEW:** Setup your cloud server in under 1 minute
- **NEW:** Premium SSD with the highest possible performance
- **NEW:** Private networks, professional API, load balancers, firewalls and many more easy-to-configure server features
- **NEW:** Virtualisation with the leading technology from VMware®
- **NEW:** Ready-to-use applications included: WordPress, Drupal™ and Magento®
- Parallels® Plesk 12
- Unlimited traffic



DOMAINS | MAIL | HOSTING | eSHOPS | SERVERS



Enter your e-mail address to get started



TRY FREE FOR 1 MONTH!*

☎ 0333 336 5509

*1&1 Cloud Server 1 month free trial with no payment details required. Visit www.1and1.co.uk for full offer details, terms and conditions.



1and1.co.uk



Create professional videos

How to turn your personal movie files into a slick production [p34](#)

Switching to a database

Ditch disorganised spreadsheets and take control of your data [p38](#)

Careers

Is it me you're looking for? [org](#)
Life as an SEO consultant [p41](#)

Create professional videos with PowerDirector 11 LE

Darien Graham-Smith introduces the professional-grade video-editing suite that headlines this month's software downloads

Home-movie footage has an undeniable charm, but it doesn't take much effort to turn a piece of video that looks distinctly amateur into something more professional. We're fortunate enough to have CyberLink PowerDirector 11 LE as part of our downloads this month (see the insert between pp66-67 for details; if there's no insert, you'll need to buy the Download edition of *PC Pro* to grab the relevant code), and the good news is that it's perfect for this job.

The LE indicates this is a "light" edition, but fear not: this is still a fully featured video-editing tool, and an excellent way to create professional videos to share online. It just lacks some capabilities of the full version: in particular, the maximum output resolution is Full HD (1,920 x 1,080), so 4K rendering isn't supported, and direct transfer to DVD and Blu-ray isn't included either. MPEG-2 and AVCHD video files can't be imported, but this shouldn't pose a big problem; almost all modern smartphones and DSLRs capture MPEG-4 files in either MP4 or MOV format, both of which are fully supported via codecs already built into Windows.

This edition of the software also comes with a limited selection of video and transition effects – but such things are superfluous anyway. Professional film-makers don't



"This is a fully featured video-editing tool and an excellent way to create professional videos to share online"

distract the viewer with crazy colour filters and animated transitions, and neither should the rest of us.

Over the next three pages, we'll walk through the process of assembling

a professional-looking video, and making it available for others to view. Although we'll focus on the PowerDirector interface, the workflow is similar in most major editing software, so if you want to get started with a different package, the same general principles will apply.

First steps

Whether you're creating a ten-second video for friends or putting together a professional TV show, the video-editing workflow follows a standard sequence. You start, naturally, by shooting and collecting together all the footage you want to use. Next, in your editing software, arrange your clips into the desired order and trim away any extraneous footage, so the movie cuts cleanly from one scene to the next. At this point you can also apply any video corrections and effects where necessary – for example,



LEFT CyberLink PowerDirector 11 LE has a friendly interface so should be easy to pick up



“PowerDirector’s Full Feature Editor isn’t difficult to use and offers far more room to experiment and learn”

Getting your clips onto the timeline

When you first start up PowerDirector 11 LE, you’ll be invited to choose either the Full Feature Editor or the Easy Editor. The Easy Editor is a simple way to turn a set of video files into a single movie, but it doesn’t give you much scope for creativity. The Full Feature Editor isn’t difficult to use, and offers far more room to experiment and learn – so we recommend you skip the Easy Editor and dive right into the main program.

Once you enter the Full Feature Editor, you’ll see the screen divided into three sections. The upper-left area shows, by default, the current library of video clips and still images that are available for use in your movie; a series of icons down the left-hand side of this pane lets you change what’s shown here. When the time comes, this area is also where you’ll find transitions and other effects.

In the upper right of the window, meanwhile, you can see a preview of the selected clip; and along the bottom half of the screen sits the timeline, which at present will be a stack of empty tracks.

You’ll notice that a collection of clips and images comes pre-loaded into the library. These are fine to play with if you’re just tinkering with the program, but if you have your own footage, it makes more sense to work with that. We’ll start therefore by removing the default clips from the library; this won’t delete them from the disk, only from this particular project. To do this, simply click anywhere in the library pane, then press Ctrl+A to select all clips, then the Delete key to remove them.

Now it’s time to import your own media, by clicking the yellow “from folder” icon at the top left of the library. You can import individual files or select an entire folder of media as needed. If your clips are in MOV format, you might need to select “All Files” in the file-import dialog to see them, since PowerDirector doesn’t show such files by default.

Once all your clips are imported, you can start dragging them onto the top track of the timeline. Arrange them sequentially as needed: to zoom in and out of the timeline, use the zoom control at the bottom left, or drag left and right in the time-code area above the timeline. To check that you have the correct clips in the correct order, you can use the preview window at the upper right to play, pause and skip around the timeline.

you might want to brighten up dark footage. You can also create transitions between scenes where appropriate, and finish the job by adding extra elements such as titles and music. When you’re happy with the way it all plays through, you can finally render the project to a new video file, ready to be shared.

Although PowerDirector has the capability to capture directly from a camera attached to your PC, most people are likely to shoot using a standalone camera. It’s worth double-checking that your device is set to a supported format – Sony DSLRs, for example, can optionally capture video in AVCHD – and also how many frames per second you’re capturing. Many devices default to 30fps, but in the UK it’s better to choose 25fps, as otherwise you’re likely to see a strobing effect from fluorescent lights.

With these settings in place, you’re ready to shoot your footage and move on to the editing stage. If you want to work with pre-existing video files in uncertain formats, don’t panic – these can be converted, either within PowerDirector or using free conversion software. This can reduce quality and smoothness, however, so it’s best avoided if possible.

Working with audio

As well as video clips, it’s possible to drag audio files onto the timeline to add sound effects or background music to your video. By default you’ll see an audio-only Track 3 available for this purpose.

Audio clips can be trimmed and dragged like regular video clips, and volume changes can be automated using envelopes. To set this up, click on the line along the middle of the audio clip to create a “node”, then drag that node up or down to fade or boost the volume at that point. To make this easier, you can expand the track view by dragging the track-dividing line in the track list.

In the same way, you can also edit the volume envelopes of video clips – click the waveform in the lower half of each clip. To move, copy or trim a clip’s audio independently of its video, right-click on the clip and select “Unlink Video and Audio”.



LEFT A few clicks can correct colour casts and brighten up murky footage

Edits, effects and transitions

Once your clips are in order, the next step is to trim away any extraneous footage that comes before and after the action. If you hover over the edge of a clip, you can click and drag to make the clip start playing from a later point, or finish earlier.

After you change the length of a clip, you'll see a dropdown menu giving you the option to shunt all subsequent footage left or right accordingly – this is called ripple editing, and it can be useful to ensure you're not left with unwanted gaps (or overlapping clips).

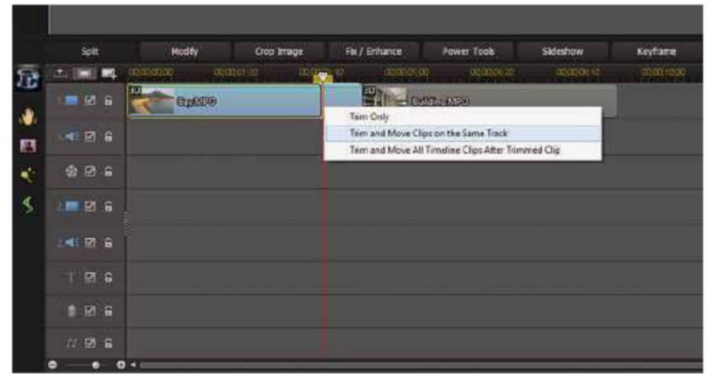
If you're working with a long clip that contains multiple scenes, you might want to split it into two or more parts. This is also helpful if you want to cut away from a clip to a different one, then cut back to the first. To achieve this, position the timeline cursor at the point where you want to split the clip, then click the contextual Split button that appears above the timeline. PowerDirector also includes a tool that tries to detect different scenes in a video and split up clips automatically: to access this function, hover over a clip in the library, then click the "Detect scenes" button that appears at its lower left.

Once you start assembling scenes into sequences, you may notice that your clips aren't all lit in quite the same way – or perhaps that all your footage is too dark, or suffers from an unwanted colour cast. You can easily adjust the appearance of a clip by selecting it on the timeline and clicking the Fix/Enhance button

above to open a new pane. Tick "Colour Adjustment" to reveal a series of sliders, allowing you to adjust the exposure, contrast, colour balance and so forth. If you wish, you can click "Apply to All" to correct all clips on the track in one go. Click the close icon at the top right of this pane to return to the library view.

The last stage is to apply any transitions as needed. We recommend that you do this sparingly: a simple jump-cut is normally less distracting than an animated transition. However, if you feel a crossfade or a jazzy transition is needed, you can access the Transition Room by clicking the relevant icon at the upper left-hand side of the interface (it looks like a frame of film with a lightning bolt in front of it).

Here you'll see a selection of transition effects. Click on one to preview it, and drag it onto the timeline to apply it. If you place your chosen transition over the start or end of a clip, you'll see a transition from or to black – or, if you're assembling your video across multiple tracks, a transition from or to whatever is on the track behind it. (In PowerDirector, each track sits "in front of" the last, so if you have clips positioned simultaneously on two tracks, the video for Track 2 will hide the video on Track 1.)



TOP Ripple editing ensures you won't be left with gaps in your movie

ABOVE Your finished project can be shared online in minutes

If you drag the transition to a point where two clips on the same track touch, the first clip will segue directly into the second, using your chosen effect: do this with the Fade transition effect to create a crossfade. Transitions appear as a cyan rectangle superimposed onto a clip; you can change the duration of a transition by simply dragging its edges.

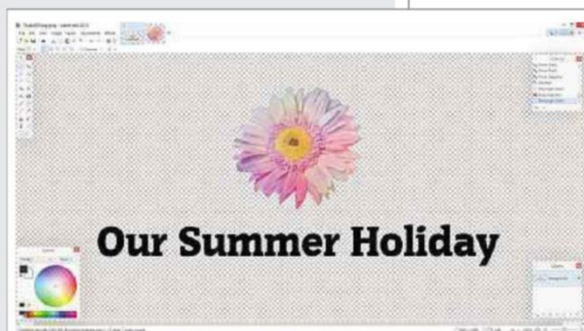
Titles and captions

Not all videos need an introduction: it's often best to jump straight into the action. And as it happens, PowerDirector 11 LE comes with only a handful of animated title cards – none of which meet our professional ambitions.

However, you can easily create your own titles and captions in any graphics program, such as the free Paint.NET (getpaint.net). Simply create a new document with a size of 1,920 x 1,080 pixels, then paint it with a suitable background colour and type your required text on top, alongside adding any graphical effects you may desire. Save this as a PNG file and import it onto the PowerDirector timeline. You can adjust its position and length, and apply transitions just as you would a normal video clip.

A similar approach can be used to create a text overlay. The difference is that this time you'll want to ensure that the background behind your text is transparent;

in Paint.NET, this is represented as a grey-and-white chequered pattern behind the text. Again, save the image as a PNG file (the JPEG format doesn't support transparency), then import it into PowerDirector and place it onto Track 2 of the timeline. You'll see Track 1 show through the transparent areas of the image, with your text superimposed.



"PowerDirector includes a tool that tries to detect different scenes in a video and split up clips automatically"

■ Rendering your video

When you're ready to render the finished product, click the Produce button at the top of the screen to switch to the production

interface. Here, under the Standard 2D tab, you can choose a format: MPEG-4 at 1,920 x 1,080 resolution will suit most purposes.

It's also possible to target specific devices, and if you click the Online tab you'll see the option to upload your video directly to Facebook or YouTube (you'll be prompted to fill in details and log in to the relevant service as appropriate). Again, the Full HD template is probably a good choice, although if you're working with low-resolution footage, you might opt to save space and upload time by choosing a lower resolution.

When you've selected suitable settings, hit the Start button towards the bottom left of the interface and PowerDirector will render your video. Job done. ●

WI-FI

Finally in any room*



- ✓ Better than any Wi-Fi repeater
- ✓ Enjoy Wi-Fi in any room*
- ✓ Best reception for smartphones and tablets



dLAN® 500 WiFi Starter Kit

- Unpack, plug in, get started
- Improves Wi-Fi reception and range
- Engineered in Germany
- 3-year manufacturer's warranty

* Required: broadband Internet connection, router and active power sockets within one property.

amazon.co.uk

The electronics specialist
maplin

currys

PC World



More information:
www.devolo.co.uk/wi-fi
Tel.: +44 (0)1865 784344
Email: sales@devolo.co.uk

devolo
The Network Innovation



Ditch messy spreadsheets and switch to a database

When it comes to storing business data, Excel isn't always the right tool.

Simon Jones shows how to migrate a chaotic set of sheets into a structured database

Last month we looked at the pitfalls of using a spreadsheet application such as Excel to store lists of data. This approach may seem like the best solution at first, but you can run into problems sharing that data with multiple users, validating the content or even navigating your data. Why? Because you're using a tool that wasn't designed to do the job.

This month we'll consider an imaginary (but typical) case of a business using a spreadsheet-based list, and look at how this could be converted to a database application to overcome such problems.

■ How workbooks get out of hand

Our list began as a simple record of projects undertaken for clients. As the company grew, so too did the number of clients, with names and contact details added to the workbook. Also, some way was needed of recording what various members of staff were doing on these projects, so even more data was added into this workbook.

At this point the spreadsheet approach became unworkable: there were far too many people trying to keep it up to date, often at the same time. The company tried instituting a



rota, so that people took it in turns to update the workbook, but this meant that some tasks were forgotten about before they were recorded.

In the end, people set up their own workbooks to keep track of their tasks, sometimes remembering to copy the data into the main workbook at the end of the week. Employees developed their own shorthand for

these books, and some changed the formatting and the order of the columns to suit their way of working. Copying this data into the main workbook resulted in a horrible mess.

This may be a made-up example, but I've actually seen all of these practices in real life. Let's take a closer look at some of the issues thrown up by this method of working.

■ Plenty of problems

You can see the first sheet of our imaginary spreadsheet below. The first column details the name of the project to which each entry refers. Some of these names are long, however, so staff may have been tempted to use abbreviations; as a result, typos have crept in. This makes it difficult to tie up which tasks belong to which project. The solution doesn't have to be difficult: you could choose a short name for each project that everyone agrees on, or give each project an ID number and translate this to the project name automatically.

There's a similar problem with the Started column. Some cells contain a date, but others record only a month – and one or two records just say “Yes”. Excel does support data validation, so it's possible to ensure

that particular cells always contain data of a particular type – but when a spreadsheet is developed in an ad hoc fashion, it's rarely used.

You won't have this problem in a database application, since the data type of the field will be fixed from the outset. If you don't know the exact date when work began, you can use the first of the month, or 1 January if you only know the year. If the project hasn't yet been started, you might leave the field blank – a NULL in database terms. If you knew the project had been started but didn't know when, you can use a date that would ordinarily be impossible for your data, such as 1/1/1900. Immediately it becomes

“At this point the spreadsheet approach became unworkable: there were far too many people trying to keep it up to date”

LEFT The existing workbook exhibits many problems, most concerning a lack of consistency and concurrency

Project Name	Started	Date Due	Client	% Complete	Status
A Scandal in Bohemia	02/12/2002		B King	95%	Monitoring
The Red-Headed League	03/11/2014		Jabez Wilson	10%	Considering
Boscombe Valley	04/10/2012	01/05/2015	Alice Turner	15%	Considering
Blue Carbuncle	07/07/2010		Helen Stoner	25%	Consulting
Speckled Band	05/03/2013	01/02/2015	Victor Hatherley	75%	Monitoring
The Sign of Four	Yes		Mary Morstan	10%	Gathering
Charles Augustus	01/03/2011		CA Milverton	45%	Investigating
Solitary Cyclist	Mar-13		Violet Smith	5%	Considering
Missing Three Quarter			Cyril Overton		Thinking
Three Students	Yes		01/01/2015 Hilton Soames	10%	Gathering Info
The Red-Headed League	03/11/2014		Jabez Wilson	10%	Considering
Boscombe Valley	04/10/2012	01/05/2015	Alice Turner	15%	Considering
Blue Carbuncle	07/07/2010		Helen Stoner	25%	Consulting
Speckled Band	05/03/2013	01/02/2015	Victor Hatherley	75%	Monitoring
The Sign of Four	Yes		Mary Morstan	10%	Gathering
Charles Augustus	01/03/2011		CA Milverton	45%	Investigating
Solitary Cyclist	Mar-13		Violet Smith	5%	Considering
Missing Three Quarter			Cyril Overton		Thinking
Three Students	Yes		01/01/2015 Hilton Soames	10%	Gathering Info
The Red-Headed League	03/11/2014		Jabez Wilson	10%	Considering

easy to sort projects and gain a chronological overview of activity.

A more subtle challenge is presented by the column labelled Client. The entries in this column aren't linked to anything else in the workbook, but there's a list of Customers on Sheet 1, which is probably what it refers to. Storing multiple lists of the same items, referred to by different names, is confusing. You need to clarify the naming and settle on an unambiguous name for this entity: are they clients or customers?

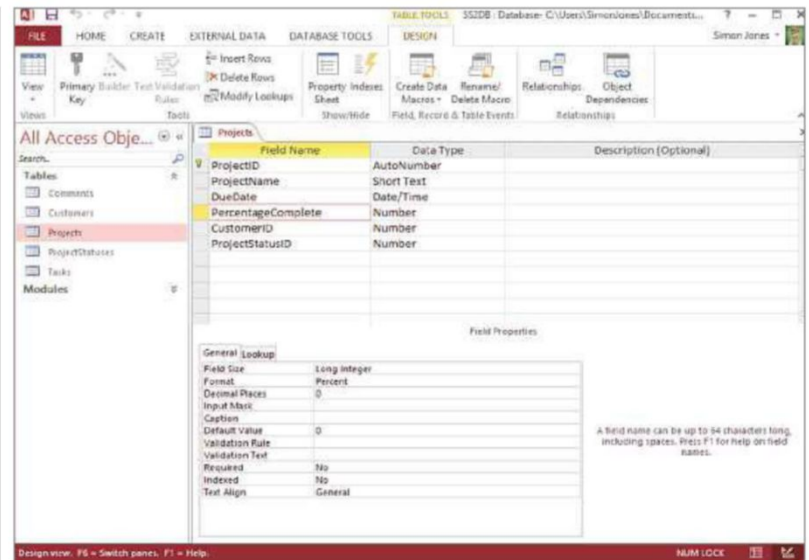
The Status column is another one where there's been no validation, so people have again opted to write whatever they want. It would be better to establish a short list of all the permissible values.

The second sheet – Sheet 1 – is just as problematic. For a start, the sheet name isn't descriptive. What it actually contains is a list headed Customers, but this isn't formatted as a table in Excel: the address is in one field, which limits your ability to use Excel's built-in tools to search or sort it. You could, for example, filter for addresses that contain "Cardiff", but the results would also include those on Cardiff Road in Newport.

When it comes to addresses, the best approach is to use separate fields for the postcode, county, city, and street (although county information is optional for UK addresses – see *No counties, please, we're British*). Street should contain everything that isn't in the other parts of the address.

There's a Contact field, which presents problems too. Where we have several contacts within a single-client business, their names have all been lumped into this field, with their phone numbers and email addresses similarly placed into the other fields. Separating these out will

RIGHT You can use the Table Design View to quickly set up your fields. The properties and lookup definitions of each field appear at the bottom



be challenging – especially if there are three names in the Contact field but only two phone numbers.

The final column in this sheet is headed Last Contacted: employees are

supposed to update this each time they make contact with a customer. Since this information is an extra thing for the employee to remember, and there's no guarantee they will – especially since

it's hidden out of the way on a second sheet – it's unreliable. This is really something the computer should be tracking automatically.

Finally we come to the Tasks sheets, which detail the tasks and comments for each worker. These aren't named consistently, and don't contain the same columns in the same order. While it makes sense for individual users to enter their data on their own sheets, the lack of coherence makes it difficult to collate and analyse the data. When a manager wants to see what work has been done on each project, for example, all the tasks have to be copied by hand from the individual sheets into one list before they can be sorted and reported on.

■ Building your database

Sorting out these issues will take some work, possibly several days. Since users will probably have to continue to use the old system while we're building a new one, it's best to make a copy of the existing workbooks from which to work. This means we'll want to document every step in converting the data, so we can quickly do it again when the time comes to switch over to the new system.

The first thing you need to do is clean the data in your Excel workbook. Using Find & Replace can help, and you should delete any

column or row that doesn't contain data (except for the column heading row, which must be kept). Add an ID column to each sheet, in column A, and populate it with incremental numbers by typing 1 in the first cell, selecting to the bottom of the data (Shift+End, Down) then using the Fill Down command (Ctrl+D). Create a master list of project names, and wherever a project name is recorded, use the VLookup() function to confirm its master ID number; if there's no number, there's an inconsistency in your data.

Once your data is clean, it's time to design a new database to hold it. We'll use Access 2013, because in our theoretical example it's available to all our users through our Office 365 subscription. When you create a new Access database, you get a choice of creating it as an Access Web App or an Access Desktop Database. Web Apps have a simplified interface and can be used only if you have Office 365 with SharePoint Online or SharePoint Server 2013 with Access Services and SQL Server 2012. We'll use the traditional Desktop Database, since it offers more options and greater control over the user experience. Full details of the differences are given at pcpro.link/246access

Select to create a new Desktop Database and name it: Access creates a new table called "Table 1", and places you into the Design View with one column, called "ID". Here you can design the tables you'll need in your database. Every table should have an ID field (an automatically incremental integer), but to avoid confusion it's best to give it a more descriptive name. In the Projects table it would be "ProjectID", "CustomerID" in the Customers table, and so on.

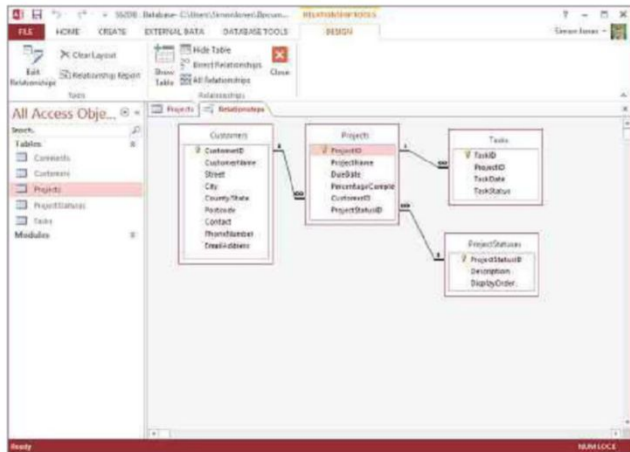
You can set the data type for every column created, and you need to give each column a name and set any other

No counties, please, we're British

If you're storing addresses in your database, it's important to understand what information you actually need. Although county information can be useful for marketing – and may be needed for some overseas addresses – it's no longer officially used in UK addresses.

The reason is that UK postal addresses rely on the concept of a "post town", where post for you is sent and sorted before it's delivered to your door. Not all towns or villages are served by post towns in the same county – for example, Melbourn (in Cambridgeshire) gets its mail through Royston (in Hertfordshire) – so specifying a county in the address doesn't necessarily help anyone.

To avoid confusion, the Post Office stopped using counties in addresses back in 1996, relying on postcode information instead – and by 2016, it plans to remove county names from the "alias data file" of supplementary address information. So, if you include a county in a UK address it will simply be ignored.



ABOVE The Relationships View on the Database Tools tab shows how your tables are related to each other

properties and formatting as appropriate for the field. As with the ID field, make sure the column names make it obvious what data should go in the field – so, for example, use ProjectName rather than just Name, DueDate rather than Due. You can use the Name & Caption button on the ribbon to create an abbreviated caption as well as the explicit name. You can use spaces in column names, but you'll have to surround them with square brackets when writing queries and reports.

Set the formatting on columns such as PercentageComplete to be Percent and dates to be ShortDate, and also the maximum length of text fields to a sensible value, or they'll all be 255 characters long. Remember that some words (such as Date) are reserved, so you can't use them as column names: use TaskDate or something else more descriptive instead.

When it comes to columns where you want to look up a value in another table (such as the Customer column in the Projects table), define those other tables in Access before you add the lookup column. When it comes to Status, the simplest option is to just type the values to be shown in the dropdown list – but this makes it difficult to add or edit the list of possible values later. Unless you're dealing with a short list where possible values are unlikely to change – such as a field recording someone's sex – it's a better idea to create another table for entries such as ProjectStatus. This allows you to easily add extra options to the list in future without a programming change.

Enhancements

While we're designing our database, we can implement improvements over the old spreadsheet-based way of doing things. One complaint our users had with their Excel workbooks was that each task contained only one cell for comments, and sometimes they needed to make more than one

comment on a task – or, the supervisor needed to make a comment about a task and then the user reply to this. Cramping everything into a single cell made it difficult to see when, and by whom, comments were made. We can do better by creating a separate table for comments, linked to the Tasks table. In this way, each task can have as many comments as necessary, with separate fields for the date, username and text of each one.

Another enhancement we can make is to set entries such as ProjectStatus to display in a particular order, rather than alphabetically – for example, you might want “Completed” to go at the bottom of the list. To do this, add a DisplayOrder column and use it to sort the lookup list. Don't be tempted to use the ID field; with this, any new records could only go on the end of the list.

To ensure our data remains clean, we can mark fields that the user must fill in as “Required”, and add validation to ensure that the data entered is in the correct form. You can make life easier by setting sensible default values: the CommentDate field on the Comments table could have its default value set to “=Date()”, which will automatically set it to today's date whenever a new Comment is created. You can use validation along with a “Withdrawn” column in a table (a Boolean) to stop users adding new records with specific values. This allows you to keep historic values that used to be valid, but that aren't used any more. These features can all be found on the Table Tools | Fields tab on the ribbon or in the Field Properties in Table Design View.

Importing your data

Once your tables are set up, you can use the External Data | Import & Link | Excel button on the ribbon to append the data from your Excel workbook to the tables in your Access database. Make a backup of your blank Access database before you start, in case anything goes wrong, and start by populating the small tables by hand if necessary. Take another backup once this is done, so you can get back to this point if anything goes wrong in the following steps.

Now import the main tables that don't rely on any other tables, such as Customers, before finishing with the tables that do have relationships, such as Projects and Tasks. If you rearrange and rename the columns in your Excel workbook to match the fields in your Access database as closely as possible, you shouldn't have any difficulty importing the data. Remember to make a note of everything you do so you can repeat it later if you need to convert the data again.

Once the data is imported, the tables in Datasheet View should work much as the Excel worksheets did – but with much better data validation, searching and sorting. If you wish, you can now start to design new forms and reports based on this data: for example, a Master/Detail form for Projects might show the data of one Project at the top of the form and a grid of the Tasks for that project at the bottom.

You could also set up a “My Tasks” form that lists all the outstanding tasks for the current user and an Overdue Tasks report that lists all the outstanding tasks for all users that are past their due date. ●

BELOW The Import Spreadsheet wizard lets you bring your Excel data into Access one table at a time

Project Name	Started	Date Due	Client	% Complete	Status
1 A Scandal in Bohemia	02/12/2002		B King	95%	Monitoring
3 The Red-Headed League	03/11/2014		Jabez Wilson	10%	Considering
4 Boscombe Valley	04/10/2012	01/05/2015	Alice Turner	15%	Considering
5 Blue Carbuncle	07/07/2010		Helen Stoner	25%	Consulting
6 Speckled Band	05/03/2013	01/02/2015	Victor Hatherley	75%	Monitoring
7 The Sign of Four	Yes		Mary Morstan	10%	Gathering
8 Charles Augustus	01/03/2011		CA Milverton	45%	Investigating
9 Solitary Cyclist	Mar-13		Violet Smith	5%	Considering
10 Missing Three Quarter			Cyril Overton		Thinking
11 Three Students	Yes	01/01/2015	Hilton Soames	10%	Gathering Inf
12 The Red-Headed League	03/11/2014		Jabez Wilson	10%	Considering
13 Boscombe Valley	04/10/2012	01/05/2015	Alice Turner	15%	Considering
14 Blue Carbuncle	07/07/2010		Helen Stoner	25%	Consulting

Shawn Harding

SEO consultant



■ What is your job?

I'm a search-engine optimisation (SEO) expert, and pay-per-click (PPC) specialist. Very simply, I help brands to be discovered online. I work in a creative marketing agency that handles promotions for clients of all sizes, and that might also include leaflet drops or magazine advertising – but my role is specifically online.

■ What does your day look like?

I spend a fair amount of time checking analytics, which enable me to stay on top of the trends among visitors to the sites we look after. There's a lot of work involved in maintaining a site's online presence: there are more than 200 factors that Google looks at to decide where you should rank for a given search phrase, the weighting of which is changed regularly, with bigger updates every so often. We need to respond to be able to respond to those movements.

■ What tools do you use?

I use a variety of tools to track website metrics. Google Analytics is the biggest one, and then there's SEOprofiler and the Moz tools. I like the Moz tools: everything you need is there, so it's easy to perform a basic audit of a site and see how it's performing. Google Webmaster Tools is useful as well – it's surprising how few developers use it.

I use a variety of website-editing packages too. Even if you have a dedicated in-house designer or developer, you don't want to be going to them every day and asking them to make tweaks, so I tend to do that myself as needed.

■ How did you get started in the SEO business?

A few years ago, I used to run my own YouTube channel, and while looking for ways to optimise it, I learnt a bit about SEO. At the same time, I was also running my own business; to promote it I needed to learn SEO principles and apply them to my own site. Through my own SEO and online promotion, my business was actually discovered and picked as a primary contractor for the London 2012 Olympics.

Along the way, I realised that there were a lot of SEO guys out there making promises, such as "we can make you the number-one hit on Google" – claiming stuff that simply wasn't true, or focusing on methods that weren't relevant any more, such as selling links to your site. I knew I could do better, so I started offering my own services on a freelance basis, and then ended up in a full-time position here.

■ What advice would you give to someone interested in the career?

You can start learning about SEO on forums such as Search Engine Watch and Search Engine Land. Moz.com will help you to understand what people are looking for, and what Google wants.

You don't necessarily need advanced technical skills – if you're comfortable in HTML and PHP, that's great, but if you're not then you can work alongside a web developer. You need copywriting ability, however. One mistake people often make is to create websites that appeal to search engines, rather than the visitor. If visitors don't find your site engaging, what's Google going to make of that?

■ Is SEO a career with a future?

Already Google is looking at semantics and searcher context when ranking search results. This means old ideas such as keyword stuffing don't work any more. A more holistic approach is needed,

and I think in time traditional SEO methods will become irrelevant. This doesn't mean the end of digital promotion as a whole, however: social media, for example, will be with us for a long time, so the focus will shift. If you want to get into this type of work, you'll need to be prepared for that change – you have to be ready to learn new skills and look at things in new ways.

■ What's the worst thing about the job?

Sometimes it can take up to six months for a change to percolate through the system. So you'll make an improvement to a site in January, say, and you may not see the benefit until July. That can be hard to explain to a client. Google, meanwhile, can just change its algorithm without warning and suddenly you'll find your site has dropped off the first page of results. This too can be difficult to explain to a client: "Your traffic is down 80%; we're working to fix it, but it may be six months before we see an improvement."

■ What's the pay like?

If you work for an agency, the pay isn't as high as if you're freelance, or employed in an enterprise-level business, but we have a range of skills on hand, such as in-house graphic designers. Plus I get paid at the end of every month. This isn't something that can be guaranteed if you're working freelance: if you take that route, there's always the risk that your clients will be hit out of the blue by a Google algorithm update and abruptly decide to take their business elsewhere. ●

£27k
Approximate
starting salary

32
Permanent jobs
(itjobswatch.
co.uk)

£38k
Average
earnings

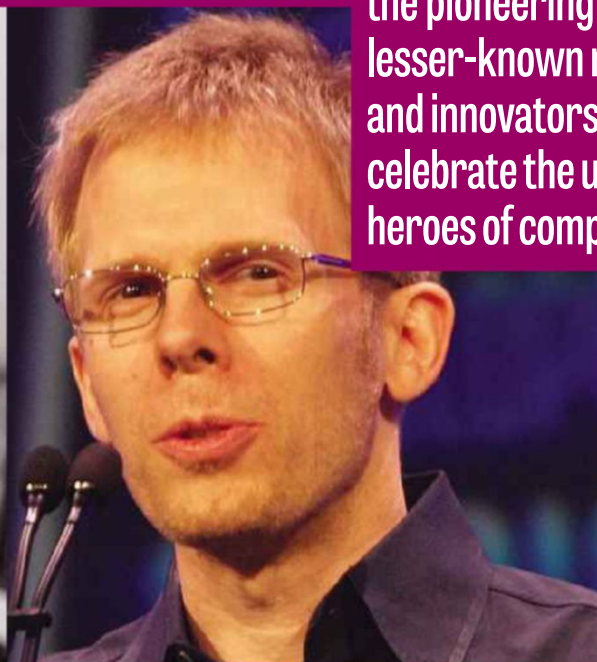
Where to start

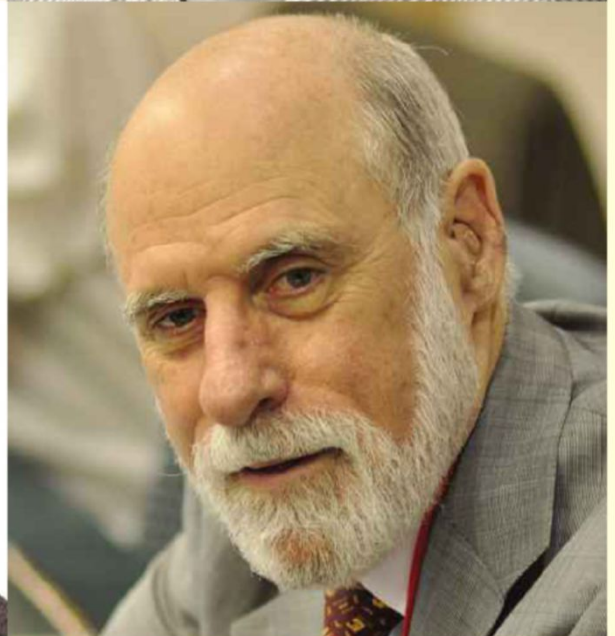
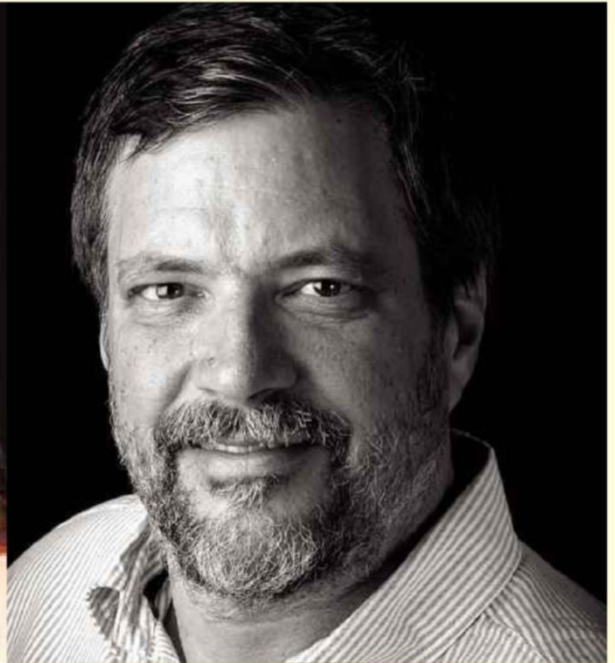
- 58 resources to help you learn and master SEO (pcpro.link/246c1)
- Major Google algorithm updates (pcpro.link/246up)
- Do you need an SEO? (pcpro.link/246seo)



IN PRAISE OF THE UNSUNG HEROES

The achievements of the IT industry's household names are founded on the pioneering work of lesser-known researchers and innovators. We celebrate the unsung heroes of computing

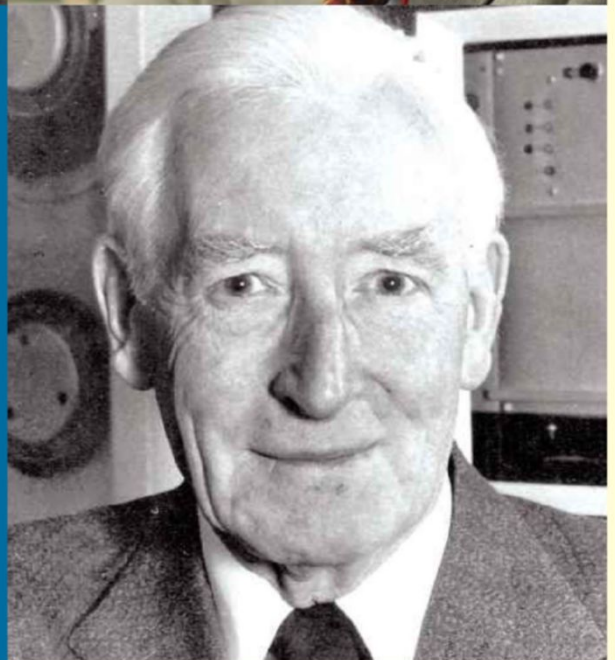




Talk about the heroes of computing and a host of familiar names are bound to surface – from pioneers such as Charles Babbage, Ada Lovelace and Alan Turing, to more contemporary examples such as Bill Gates, Steve Jobs and Linus Torvalds.

Yet the truth is that the greatest visionaries rarely work alone. Just as Isaac Newton, one of the fathers of modern science, modestly acknowledged that he “stood on the shoulders of giants”, so the best-known names in computing have frequently built on the cumulative achievements and research of lesser-known – but no less important – researchers and inventors.

So it's time to turn the spotlight on some of those underappreciated figures of computing, and give them the recognition they deserve. On the pages that follow, our experts nominate their own unsung heroes in a variety of fields, from security to graphics and business productivity, and set out their impact on computing. And on p46, you'll also find the results of our reader poll of your own computing heroes – in which the big-hitters of computing rub shoulders with some names that may surprise you.





THE UNSUNG HEROES OF ... SECURITY



Davey Winder names the heroes who've made e-commerce possible and saved countless lives

Phil Zimmermann

If anyone in the data-security business deserves to be called a hero, it's Phil Zimmermann. In 1991, he developed Pretty Good Privacy (PGP), the first email-encryption product that allowed ordinary internet users to secure their email communications. What's more, he published it for free, at a time when the only organisation with real email privacy was the US government.

The official response was to declare his software a "weapon" and ban it from being exported: when Zimmermann travelled, his laptops were regularly searched (normally by people who had no idea what they were looking for). He was even investigated under the Arms Export Control Act, the argument being that distributing the software online might be a form of export.

It took five years for the US to relax its position on PGP; Zimmermann deserves recognition not only for the importance of his software, but also for what he went through for the greater good.



Peter Gutmann

For most of us, "data security" means worrying about how to protect your valuable information. In 1996, Peter Gutmann published a paper addressing a more insidious issue: what to do with data that you don't want any more. He foresaw the growing issue of disposing of hardware that might contain traces of confidential data that shouldn't fall into the wrong hands.

Accordingly, he developed a process of data destruction known as the Gutmann method, whereby the contents of a hard drive are overwritten by a series of 35 patterns, erasing the data so securely that not even someone with a magnetic-force microscope and plenty of determination could stand a chance of getting it back.

While the full 35-pass method is overkill for modern drives, Gutmann's approach is intended to be secure enough to reliably wipe any type of disk. He deserves recognition for identifying a key data-security problem and proposing a robust solution to it, giving data privacy its deserved prominence.

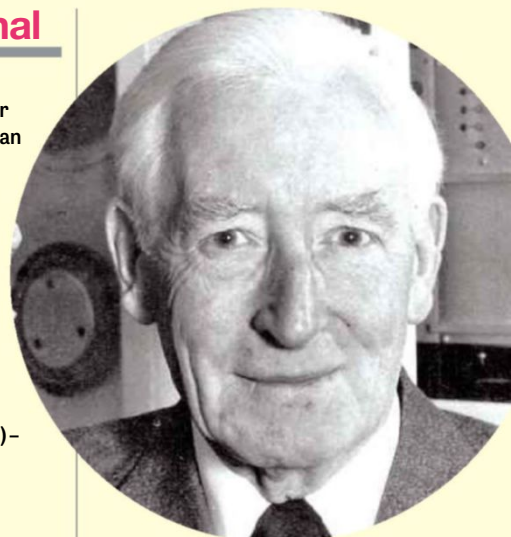
Dr Taher Elgamal

Next time you place an online shopping order, thank Dr Taher Elgamal – the Egyptian-American cryptographer who more or less single-handedly kicked off the e-commerce revolution.

Elgamal was behind several breakthroughs in online cryptography. In the mid-1990s, as chief scientist at Netscape Communications, he was responsible for the introduction and promotion of the Secure Sockets Layer (SSL) – the technology that enables end-to-end security for credit card transactions and VPNs. Although SSL has largely been replaced by Transport Layer Security (TLS) these days, it was Dr Elgamal who first introduced trust to the online world, transforming the internet into a channel for real-world business.



"He introduced trust to the online world, transforming the internet into a channel for real-world business"



Tommy Flowers

My final nomination isn't for a code-maker, but for a codebreaker. Pretty much everyone knows about Alan Turing's work in this area, which is credited with shortening World War II. Unfortunately, the focus on Turing tends to overshadow the work done by his Bletchley colleague Tommy Flowers.

The son of a bricklayer, Flowers had originally joined the General Post Office in 1926 to research the (then largely theoretical) development of electronic telephone exchanges, but when an Enigma machine arrived at Bletchley Park, it was Flowers who immediately envisioned the possibility of creating a computer to decrypt it. Thus he set about building the Colossus computer – despite a lack of enthusiasm from the Bletchley Park management, who gave him minimal support and let him fund the project partly from his own pocket.

Without Colossus, Turing and his team would have struggled to crack the Enigma code, and the war might have continued for many years longer. Flowers received an MBE for his work, but the £1,000 payout he was awarded after the war by the government didn't even cover the cost of building the computer.

Images: Taher Elgamal, Alexander Kirik; Tommy Flowers, BT Archive; Peter Gutmann;



THE UNSUNG HEROES OF ... PROGRAMMING



Computer-science tutor David Hunt names the key programming figures of the past – and the future



Sebastian Thrun

Sebastian Thrun is a man with many hats: he's a vice president at Google, a part-time professor of computer science at Stanford University and CEO of educational organisation Udacity. What makes Thrun's research particularly interesting is his focus on robotics and artificial intelligence.

In the course of his work, Thrun has developed a number of autonomous robots, including a driverless car that he entered into the 2005 DARPA Grand Challenge – a contest to design a car that could follow a 150-mile off-road route across the Mojave Desert in the United States without human intervention. His team addressed the problem by creating software that worked out the optimum route using laser scanners and range finders placed on the car. His car, Stanley, became the first winner of the challenge, after driving autonomously for almost seven hours.

Thrun is now working on Google's driverless car systems. With the UK government ruling to allow driverless cars onto public roads in January 2015, his work is set to revolutionise our transport habits in the next decade.

Edsger Dijkstra

In the late 1950s, Dutch computer scientist Edsger Dijkstra developed an algorithm to find the shortest path between two points. This may not sound revolutionary, but it has endless applications in the modern world – navigating the road using satnav, or in a web-based mapping system such as Google Maps, for example.

Dijkstra is also notable for a letter he wrote to the editor of the Association for Computing Machinery in 1968, which was published under the playful heading "Go To Statement Considered Harmful". In it, he suggested that the Go To statement should be abolished from high-level languages, advocating a structured programming approach instead. In his time, he was one of the most influential thinkers about programming,



"Dijkstra suggested that the Go To statement be abolished from high-level languages"



Satoshi Nakamoto

The mysterious Nakamoto has been credited with the invention of the Bitcoin protocol, although there are doubts as to whether he exists. It's been suggested that this pseudonym may in fact represent a group of coders who, for their own reasons, want to remain anonymous.

Whoever created it, Bitcoin represents a great achievement of software design. I'm in awe of Nakamoto: working in software, he had the vision to create a new currency and turned our understanding of traditional banking on its head. The value of bitcoins has fluctuated wildly in the past few years: at the time of writing one coin is worth £210, up from around 4p in 2010. What's the difference between spending virtual money as bitcoins and spending it via credit card on a website?



Martin Dougiamas

Dougiamas is a computer scientist and educator, and for me an important figure thanks to his recognition that non-technical people tend to struggle with electronic learning systems.

In 1999, he began developing a project called Moodle (modular object-oriented dynamic learning environment) – an open-source learning management system used by millions of students to study online courses in industry and universities around the world.

Moodle's key point is its focus on social interaction and collaboration, making both the system and the subject matter more accessible. As virtual education becomes more commonplace, it's likely that Dougiamas' work will become increasingly influential. As an educator, I also salute Dougiamas for making his solution open source.

Gennady Korotkevich

At just 20 years old, Gennady Korotkevich has already made his mark on the programming world by winning a range of international competitions. He has won Gold for six consecutive years at the International Olympiad in Informatics, an annual event open to secondary-school pupils. Typically, contestants have to solve three problems within five hours, working on their own with a computer using C, C++ or Pascal (Java is being introduced next year).

Among many other achievements, Korotkevich was also the Google Code Jam 2014 winner, beating contestants from around the world. His focus is currently on "sport programming", in which he competes to solve problems by writing computer programs as quickly as possible.

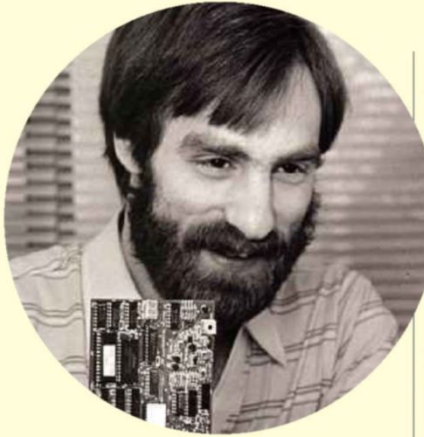




THE UNSUNG HEROES OF... OPERATING SYSTEMS



Jon Honeyball names the innovators whose work underpins the rich interfaces we enjoy today



Tim Paterson

Back in early 1980, Tim Paterson worked at Seattle Computer Products, developing motherboards for the new Intel 8086 CPU. The platform was struggling, however, because CP/M – the standard small OS at the time – wasn't available for this architecture. So Paterson did what any true geek would do: he set about writing his own operating system. The first release of QDOS (the "Quick and Dirty Operating System") was completed in three months. By the end of 1980, it had been renamed 86-DOS and had grown through a number of iterations – at which point the rights were purchased by Bill Gates. 86-DOS became MS-DOS and the rest, as they say, is history.

Paterson is a hero not merely because he was in the right place at the right time: he saw a need and put in the work to address it.

David Cutler

Now a senior technical fellow at Microsoft, Cutler's early work included the development of the VAX superminicomputer and the VAX/VMS OS at the Digital Equipment Corporation.

When DEC financially imploded in the mid-1980s, Cutler moved to Microsoft and started work on a portable 32-bit OS that became Windows NT – the bedrock of Microsoft's OS offerings. He's now in the cloud services team – which works on Azure and its underlying OS and VM technology – so his influence looks certain to continue growing.

Perhaps surprisingly, Cutler is notoriously press-shy, and is reputed to have a fiery temper. Reportedly, he once punched his way through a recalcitrant coder's door; I've seen what is claimed to be that door, although I can't verify the story.



Avie Tevanian

Avie Tevanian worked at Carnegie Mellon University on the Mach kernel, which became the underlying OS for Steve Jobs' NeXT platform – the extremely powerful but unsuccessful project that occupied Jobs while he was away from Apple.

NeXTStep was extraordinary: I'll never forget the way it used PostScript for onscreen graphics, nor the overall beauty and simplicity of the user interface, which was clearly designed by a small team. Everything about the platform screamed quality, and it was a huge shame it wasn't more successful.

Happily, some part of NeXTStep lives on: when Jobs returned to Apple in 1997, Tevanian came with him. Mach became the underlying kernel of OS X, resulting in early builds of the OS having a curious hybrid feel to them. OS X has been a life-saver for Apple: it has underpinned the resurgence of interest in Apple's desktop and laptop platforms, and also provides the foundation for iOS, which has clearly been hugely successful.

It's a shame that Apple never properly developed the OS for server roles, staying away from the items that made Microsoft Windows Server so successful in the business and enterprise space. But perhaps Apple was wise not to invest too heavily in that fight and instead focus on the mobile space.



Although Tevanian left Apple in 2006, his work on Mach, NeXTStep and OS X still lives on today in half a billion iPhones worldwide and beyond – and for that reason, he earns his place as one of my top three OS heroes.

"NeXTStep was extraordinary; it screamed quality – it's a shame it wasn't more successful"

Images: David Cutler, John P Back; Tim Paterson, Computerhistory.org; Avie Tevanian, Apple

YOUR COMPUTING HEROES

We asked *PC Pro* readers to nominate their own computing heroes – here's who you chose, and why

Sir Tim Berners-Lee

With almost 15% of the vote, the British inventor of the World Wide Web was the single most popular figure in our poll. "Without Berners-Lee's pioneering work, I'd know a lot less about cats and Jedi," wrote Chris Timms. Readers praised Berners-Lee's motivations, as well as his achievements: Richard Taylor thanked Berners-Lee for "choosing to share his revolutionary technology for the use of humankind, rather than going down the corporate 'it's mine' trademark and profit route".

Alan Turing and Tommy Flowers

In recent years, wartime computing innovator Alan Turing has begun to receive the recognition he deserves. As Andrew Earle succinctly put it: "Turing devised a revolutionary machine against the odds, and saved countless lives in the process." Many readers also remembered Tommy Flowers (*see p44*), who worked alongside Turing – "a true pioneer who designed the world's first programmable electronic computer," wrote Gary Akehurst.

Sir Clive Sinclair

Today, the rubber-keyed ZX Spectrum seems primitive, but 8% of readers recognised how, in the 1980s, Sinclair was a key driver of home computing in Britain. "When I was a child, Sinclair made computers affordable enough for me to own, and simple enough for me to use," said Steve Pouncey. Rick Dickerson recalled how Sinclair inspired "the first real generation of home-computer geeks". "I bought one with my first wage packet in 1983," added *PC Pro* contributing editor Kevin Partner.

THE UNSUNG HEROES OF... NETWORKING

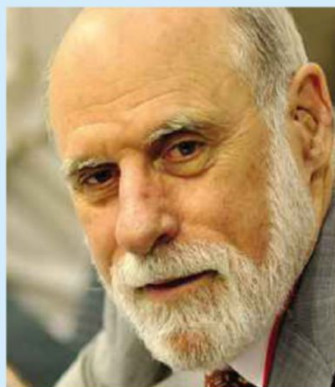


Networking is complex stuff. Steve Cassidy celebrates the work of those who brought it to the mainstream

Vint Cerf

If you're a "networks person" you may feel that Vint Cerf is hardly unsung, but to the man in the street the name means nothing. Yet his influence is universal: there could be no internet without a means for devices to talk to one another over unreliable links, and Cerf made that possible by creating TCP/IPv4.

It's a measure of the quality and foresight of Cerf's work that it has lasted twice as long as he expected it to, covering the planet with four billion addresses. We're reaching the limit of where IPv4 can take us, however: an update is urgently needed so the internet can continue expanding into new communities and across more devices. Perhaps the comparatively slow adoption of IPv6 can be explained by the fact that it's the product of a committee, rather than an individual hero.



Ray Noorda

Noorda's name isn't one that frequently bothers the headlines these days, but back in the early days of business networking he was the CEO of Novell who took the bold decision to sell Ethernet cards for PCs at a loss. Before that decision, it had been a four-figure investment to add a PC – or an Apple II, or an Apricot – to a mainframe or minicomputer LAN. Noorda squeezed that down to a "bargain" \$250.

The result was a boom in networking and tremendous success for Novell itself. Even though it was often other people's networks running over Novell's infrastructure, it was Noorda's overall approach that cemented the idea that computers work better when they're connected together. Without that push, the state of networking as a whole would be years behind where we are now.

Vic Hayes

Let's say this as brutally as possible: while networking experts like to think in terms of miles of CAT-6 cable, for the majority of humanity, networking is wireless. Yet, incredibly, it all hangs together seamlessly, because our tablets and laptops use exactly the same protocols and rules of configuration as a wired LAN.

This wasn't a foregone conclusion. There were plenty of precedents for crazy alternative methods of connection, and indeed there remain some wayward approaches out there. France Telecom, for example, gives some home users "Wi-Fi" base stations that in fact use Bluetooth, not Wi-Fi. This leads to much hilarity when the users come to the UK and mysteriously can't connect to anything.

That such situations are the exception is thanks to Vic Hayes – chair of the charmingly named IEEE 802.11 Standards Working Group for Wireless Local Area Networks – who saved us all a world of pain by ensuring that Wi-Fi would use existing standards. Despite his importance, Hayes is a name you have to search for carefully: Wi-Fi's genesis came sufficiently late in the internet age that web searches are



likely to turn up fascinating but misleading diversions, such as the role of golden-age Hollywood actress Hedy Lamarr in developing techniques for improving bandwidth.

"There were plenty of precedents for alternative methods of connection"

HONOURABLE MENTIONS

Bill Gates

Although not as widely admired as Sinclair, the Microsoft co-founder took the runner-up place. "Gates did more to bring PCs to the masses than any other individual," wrote Tim Cutting. Peter Ward agreed: "He had the vision of 'a PC on every desktop', and made it a reality." Praise for Gates didn't focus solely on his computing career, but also on his work since with the proceeds. "He's using his fortune to help change the world for the better, and continues to behave with integrity," concluded Ward.

Charles Babbage

"His purpose for getting into computing was the very practical one of doing away with mistakes caused by manual calculations, and he was aware of the need for usability." **Michael O'Donnell**

Jay Miner

"As the father of the Amiga, he arguably changed home computing more than anyone other than Sir Clive Sinclair."

Ryan Thomas

Steve Wozniak

"With his product ideas, elegant design, and basic concept that computers should benefit the user first, it was Wozniak who established the core values of Apple." **John Melville**

OTHER NOMINATIONS

Frederick Brooks Software engineering guru

Steve Furber Architect of the BBC Micro and ARM processor

Alan Kay Innovator of object-oriented programming

Don Knuth Programming educator and developer of TeX

Ada Lovelace Victorian programming pioneer

Alan Sugar Mass-market electronics entrepreneur

Linus Torvalds Creator of Linux and open-source champion

THE UNSUNG HEROES OF... GRAPHICS



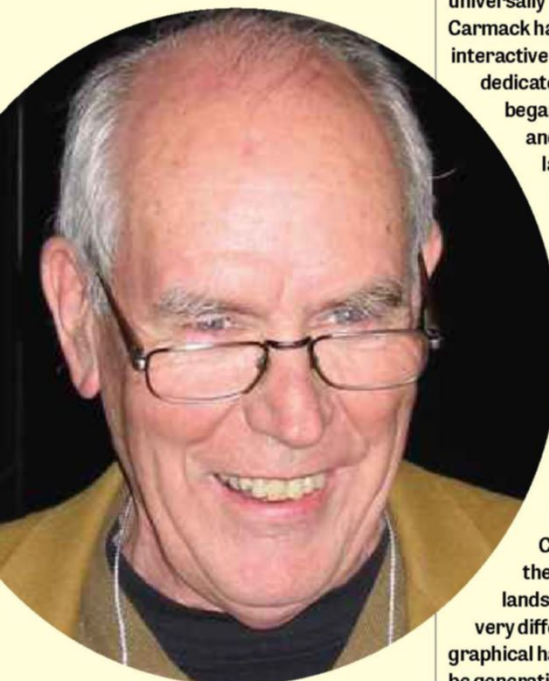
Darien Graham-Smith praises four creators whose visual innovations have stood the test of time

Ivan Sutherland

Ivan Sutherland is credited with inventing modern CAD software in 1962, and developing the graphical user interface. Perhaps his most ambitious project was the Sword of Damocles – a fully functional virtual-reality system, built in 1968 at the University of Utah (see p113). The CRT-based headset implemented binocular vision, creating an impression of a three-dimensional world, and used head-tracking to allow the display to follow the user's view.

The device was limited to black-and-white graphics – and weighed so much that it had to be suspended from the ceiling so as not to break the user's neck – but its potential was evident. In his paper describing the experiment, Sutherland noted that “observers uniformly remark on the realism of the resulting images”.

More than 40 years on, we're only just starting to see viable personal virtual-reality systems – a striking reminder of just how far ahead of his time Sutherland was. The floodgates may be about to open, however: on p68 we review the Samsung Gear VR headset, developed in partnership with California-based VR specialist Oculus – whose CTO is none other than one John Carmack.



John Carmack

John Carmack was the lead programmer on a series of influential 1990s games – notably Wolfenstein 3D, Doom and Quake. At a time when 3D was primarily associated with ray-tracing approaches that took hours to produce a single frame, Carmack pioneered a whole new genre of fast-moving, first-person action games.

The computing techniques he innovated to make such games possible are often praised for their sheer cleverness. But perhaps more significant is Carmack's greater influence on the course of computer graphics. Previously, computer games had been almost universally flat, side-on affairs. Once Carmack had shown the potential of interactive 3D, everything changed:

dedicated 3D accelerator cards began to appear for the PC, and games consoles launched with fully 3D-capable hardware. The race was on to produce hardware capable of rendering ever more detail at ever higher resolutions.

Today, even the lowliest GPU built into a budget processor can produce astonishing levels of detail. Without Carmack's influence, the entertainment landscape might look very different today, and our graphical hardware would likely be generations behind.

Edwin Catmull

Ed Catmull is president of Walt Disney Animation Studios (and its subsidiary Pixar) – but his journey to corporate success started in the computer lab.

In the early 1970s, as a PhD student of Sutherland's, he developed several advanced graphical techniques, including texture mapping and bicubic patches, as well as independently discovering Z-buffering. Significantly, he was one of the first pioneers in the field to see the potential of computer graphics in film; before graduating, he had created an animation of a human hand that featured in the 1976 film *Futureworld*. Three years later, he was vice president of the computer graphics division at Lucasfilm, and then in 1986 became CTO of Pixar under Steve Jobs, where he worked on the rendering systems that would produce the studio's iconic animated movies, such as *Toy Story* and *Finding Nemo*.

As both a visionary and a computer artist himself, Catmull has done more than anyone to promote and fulfil the creative potential of computer-generated cinema.



“As a PhD student, he developed several graphical techniques”



Thomas Knoll

In 1987, while studying computer science, Thomas Knoll created a simple program to display images on the Macintosh Plus. His brother John – who at the time worked for visual-effects company Industrial Light & Magic – encouraged him to develop it into a general-purpose image-editing tool, and agreed to help him market it. A year later, Photoshop was licensed to Adobe.

Although the original release of Photoshop would appear to be extremely basic today, Knoll was dedicated to constantly adding features. A year after the initial release, EPS and CMYK support were added, allowing Photoshop to become the backbone of the emerging digital print industry. Windows support followed in 1993, and a continuing stream of enhancements and new features has ensured that Photoshop's position has remained unassailable ever since.

Needless to say, keeping up the momentum long ago became a job too big for Knoll to handle alone: the credits for the latest version of Photoshop list more than 200 names. But Thomas Knoll remained the lead programmer until 2008's Adobe CS4 release, and – with a little help from his brother – can claim the credit for developing perhaps the most widely used and influential creative tool in history.



Fast ► Resilient ► Exhilarating

Unlimited Business Internet from £29 per month, with free connection and router*

► **Whatever your budget, we have a fast, resilient solution to suit your business needs.**

FibreStream®

- Fibre Ethernet Leased Lines
- 10Mb to 1Gb
- Auto failover (optional)
- From £300 per month
- Free connection*

CopperStream®

- Copper Ethernet GEA/EFM Leased Lines
- 2Mb to 35Mb
- Auto failover (optional)
- From £125 per month
- Free connection*

DualStream®SF

- SDSLM and VStream®
- 2Mb voice and up to 76Mb data
- Auto failover
- From £99 per month

VStream®

- Fibre Broadband (VDSL)
- Up to 76Mb
- Auto failover (optional)
- From £21 per month
- Free connection and router on most services*

SPITFIRE®
VOICE • INTERNET • DATA



Specialists in business-class Internet connectivity, SIP and Voice over IP.

Call Spitfire on 0800 319 6300
or visit our website
at www.spitfire.co.uk

For Partner Service details,
call 0800 319 6500

* Terms and Conditions apply. All prices quoted are monthly rentals. All products suitable for converged voice and data.



Innovative • Flexible • Reliable • Supportive
Telecommunication Services to Business since 1988

www.spitfire.co.uk



THE UNSUNG HEROES OF... PRODUCTIVITY



Simon Jones names the individuals who've helped us to get more done, and do it better

Jensen Harris and Julie Larson-Green

Between 2003 and 2007, Harris and Larson-Green were leading members of a team at Microsoft that completely rewrote the book on user interfaces. They threw away the menus and toolbars that had been in use since the first days of graphical user interfaces in the 1970s, replacing them with the Microsoft Office Fluent UI, also known as the ribbon.

A staggering amount of work went into analysing, designing, and proving this radical new user interface, which affects millions of people in their everyday work. It rescued users from the confusing array of toolbars, task panes and menus that "helpfully" hid commands you hadn't used for a while – thereby guaranteeing that you'd never find them again. Microsoft's own figures reveal that, before the release of Office 2007, 75% of the "new features" being requested by users were in fact already present in the software.

Although the change had its detractors, surveys show that more than 80% of users think the ribbon makes Office more intuitive and more fun to use – and a whopping 88% of users agree that it makes it easier to create professional-looking documents. Before Office 2007, it was cynically suggested that Microsoft Office was complete and needed no further updates: Harris and Larson-Green proved that idea wrong.



"A staggering amount of work went into analysing, designing and proving this radical new UI"

Ted Codd and Chris Date

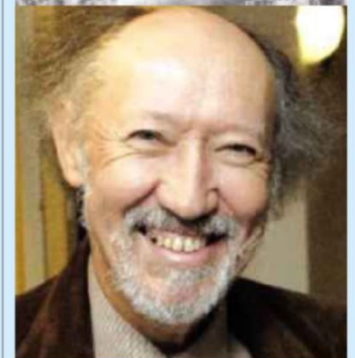
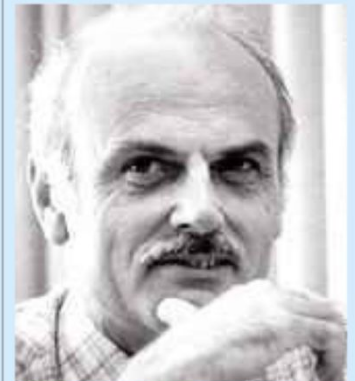
British computer scientists Ted Codd and Chris Date were two men from different eras. Codd was born in 1923 and studied at the University of Oxford before becoming a pilot in the RAF in World War II; Date was born 18 years later and went to Cambridge. In the 1970s, however, they both worked for IBM, and together developed a hugely important framework for handling large quantities of data.

The key work was Codd's 1970 paper *A Relational Model of Data for Large Shared Data Banks*, which proposed arranging data into tables of columns and rows, with relationships between the tables formed by putting the key values from one table into the other. His invention of the relational database led IBM to create a query system known as the Structured English Query Language – SEQUEL for short, which was quickly renamed SQL to avoid treading on the toes of an existing trademark.

This led in turn to the rise of Oracle, and of Microsoft's SQL Server – technologies that are today ubiquitous in business and government. Date helped Codd develop and extend the relational model, including work on the normalisation of data. In 1985, Codd published his 12 Rules for Relational Database Systems.

Codd and Date eventually left IBM to set up their own consulting firm. Codd received the Turing Award for his

work in 1981, and in the same year Date wrote a book on relational databases: his *Introduction to Database Systems* is now in its eighth edition and is used by universities around the world; I've still got my copy. Although Codd passed away in 2003, Date is still writing: his latest book *The Third Manifesto* is a proposal, written with Hugh Darwen, for the future of database-management systems.



Edward Tufte

Edward Tufte is an American professor, statistician and writer who now works at Yale University. He's best known for his work on information design and data visualisation: in the 1970s, he taught statistics to journalists, and this led to his influential 1982 book *The Visual Display of Quantitative Information*.

At that time, Tufte's work addressed a select group of communicators and professional illustrators. But with the rise of PowerPoint, his work takes on a much wider relevance, and over the years he's often criticised the overuse (and misuse) of presentation software. He can certainly be considered a hero for his extensive efforts to save us from "death by PowerPoint".

It's worth mentioning that Tufte also invented the Sparkline, introducing the idea in his 2006 book *Beautiful Evidence*. Microsoft filed a patent in 2008 concerning sparklines in Excel 2010; given his own prior publication, I think Tufte is right to declare that Microsoft's claims expose "the ridiculous state of the US patent system". ●





► SIP Communicator™

The flexible and cost-effective option
- however big your business family grows

► **Cutting edge technology - save up to 50% against traditional telecommunications**

SIP Communicator™ is ideal for:

- Small to medium sized businesses
- New business start ups
- Multiple locations
- Homeworkers
- Seamless working between locations

Benefits of SIP Communicator™:

- Business features - voicemail, call forwarding, hold, transfer and more
- Free calls between sites
- Extremely cost effective to set up
- Minimum contract of just 3 months provides maximum flexibility

SPITFIRE®
VOICE • INTERNET • DATA



All prices quoted are monthly rentals. All products suitable for converged voice and data.

Specialists in business-class Internet connectivity, SIP and Voice over IP.

**Call Spitfire on 0800 319 6300
or visit our website
at www.spitfire.co.uk**

**For Partner Service details,
call 0800 319 6500**



Innovative • Flexible • Reliable • Supportive
Telecommunication Services to Business since 1988

www.spitfire.co.uk



Crafting PCs the Scan way: Specification. Service. Satisfaction.



Video Editing Systems

Edit, grade and deliver with breakthrough performance. Experience true RAW cinematography workflow in real-time on our range of Scan 3XS Pro Video workstations.



3XS Evolve NLE HD Plus

- Intel® Core™ i7 4790K overclocked to 4.4GHz
- 16GB Corsair 2133MHz DDR3 memory
- 2GB NVIDIA GeForce GTX 760
- 120GB SSD + 240GB SSD
- 3 Year Premium Warranty
- Microsoft Windows 7 Pro 64-bit

£1379 Inc VAT



This high performance 3XS system is optimised for editing HD video with an overclocked quad-core Intel Core i7 4790K plus a 120GB SSD for Windows plus a dedicated super-fast 240GB SSD for your current project.



Music Production Systems

Our Pro Audio workstations are fully optimised for studio and music production duties. We test our music production PCs with a wide range of software & hardware with a focus on building powerful, quiet audio solutions so that you can simply get on with writing and producing great music.



3XS EL97

- Intel® Core™ i5 4690K overclocked to 4.4GHz
- 8GB Corsair 1600MHz DDR3 memory
- Intel HD graphics
- 1TB low-noise HDD
- 3 Year Premium Warranty
- Microsoft Windows 7 Home Premium 64-bit

£799 Inc VAT



Our EL97 music production computer solution is based around the mid-range Intel Core i5 chip giving you a total of four cores of processing power. This audio system is designed for those with more modest music making requirements and is suitable for music recording, sound editing and other general music production duties.



3XS Evolve NLE 4K

- Intel® Core™ i7 5820K overclocked to 4.2GHz
- 32GB Corsair 2600MHz DDR4 memory
- 4GB NVIDIA GeForce GTX 970
- 120GB SSD + 240GB SSD
- 3 Year Premium Warranty
- Microsoft Windows 7 Pro 64-bit

£1999 Inc VAT



This high performance 3XS system is optimised for editing 4K video with an overclocked six-core Intel Core i7 5820K plus a 120GB SSD for Windows plus a dedicated super-fast 240GB SSD for your current project.



3XS HA97 PowerDAW

- Intel® Core™ i7 4790K overclocked to 4.4GHz
- 8GB Corsair 1600MHz DDR3 memory
- 120GB SSD + 1TB low-noise HDD
- Fanless case, CPU cooler and PSU
- 3 Year Premium Warranty
- Microsoft Windows 7 Home Premium 64-bit

£1074 Inc VAT



The HA97 PowerDAW is our most popular computer music PC. A great all-rounder solution designed for I.T.B (in the box) production duties with plenty of scope for further expansion, makes it suitable for home and pro studios alike. Sporting a 4.4GHz CPU with up to 32GB of memory as well as noise management thanks to carefully chosen components.



Finance Available on
PCs above £300



Built by award
winning 3XS team



Tailored to your
requirements



Fully soak tested



Fully 3XS
compatible



Work and play with Intel Inside® The most awarded PCs and Laptops Period.



2D & 3D Graphics Systems

A range of powerful workstations for professional graphics artists, modellers, animators and architects. All of our Pro Graphics systems have workstation-class NVIDIA Quadro GPUs, which have certified drivers for all the leading graphics creation applications.



3XS GW-HT20

- Intel® Core™ i7 5960X overclocked to 4.2GHz
- 32GB Corsair 2666MHz DDR4 memory
- 4GB NVIDIA Quadro K4200
- 250GB SSD + 2TB HDD
- 3 Year Premium Warranty
- Microsoft Windows 7 Pro 64-bit

£2799 Inc VAT



The GW-HT20 features the 8-core Intel Core i7 5960X CPU with Hyper-Threading which we overclock to 4.2GHz. This very powerful CPU is partnered with the high-end 4GB NVIDIA Quadro K4200 graphics card. Also included is 16GB of high bandwidth 2666MHz Corsair DDR4, a 250GB Samsung SSD and 2TB Seagate hard disk.



Gaming Systems

Scan 3XS Pro Gaming systems are engineered to give you an edge over your competitors in the latest games. Each model has the perfect blend of cutting edge components to help you pwn noobs without having to break into a sweat. Our range includes powerful tower systems, miniature marvels and gaming laptops for all budgets.



3XS Z97 Vengeance 980

- Intel® Core™ i7 4790K overclocked to 4.7GHz
- 8GB Corsair 2133MHz DDR3 memory
- 4GB NVIDIA GeForce GTX 980
- 240GB SSD + 2TB HDD
- 3 Year Premium Warranty
- Microsoft Windows 8.1 64-bit

£1569 Inc VAT



Our highly popular Vengeance gaming system is based around the immensely powerful NVIDIA graphics card, the 4GB GeForce GTX 980. To make that the GTX 980 isn't held back this awesome gaming PC also includes an Intel Core i7 4790K overclocked to 4.7GHz which is accompanied by 8GB of RAM, a 240GB SSD and 2TB hard disk.



3XS GW-HTX30

- Two Intel® Xeon® E5 2640 V3
- 32GB Crucial 2133MHz DDR4 ECC
- 4GB NVIDIA Quadro K4200
- 240GB SSD + 2TB HDD
- 3 Year Premium Warranty
- Microsoft Windows 7 Pro 64-bit

£3857 Inc VAT



The GW-HTX30 marks a giant leap forward in performance thanks to having two 8-core Intel Xeon E5 2640 V3 CPUs. These are partnered with a 4GB NVIDIA Quadro K4200 professional graphics card and 64GB of 1600MHz ECC Registered DDR3 plus a 240GB SSD and 2TB HDD.



3XS Graphite LG1720

- Intel® Core™ i7 4710HQ processor
- 17.3" FullHD 1920 x 1080 screen
- 8GB Corsair 1600MHz DDR3 memory
- 3GB NVIDIA GeForce GTX 970M
- 3 Year Premium Warranty
- Microsoft Windows 8.1 64-bit

£1149 Inc VAT



The LG1720 is a 17.3" high-end gaming laptop that includes a choice of powerful NVIDIA GeForce GTX 970M or 980M graphics card, ensuring silky smooth frame rates in all games. The LG1720 is ready for next-day delivery and has a 2 Year Warranty.



Scan 3XS
Overclocked



Built by award
winning 3XS team



3 Year
Warranty

3XS SYSTEMS



FROM IDEA TO

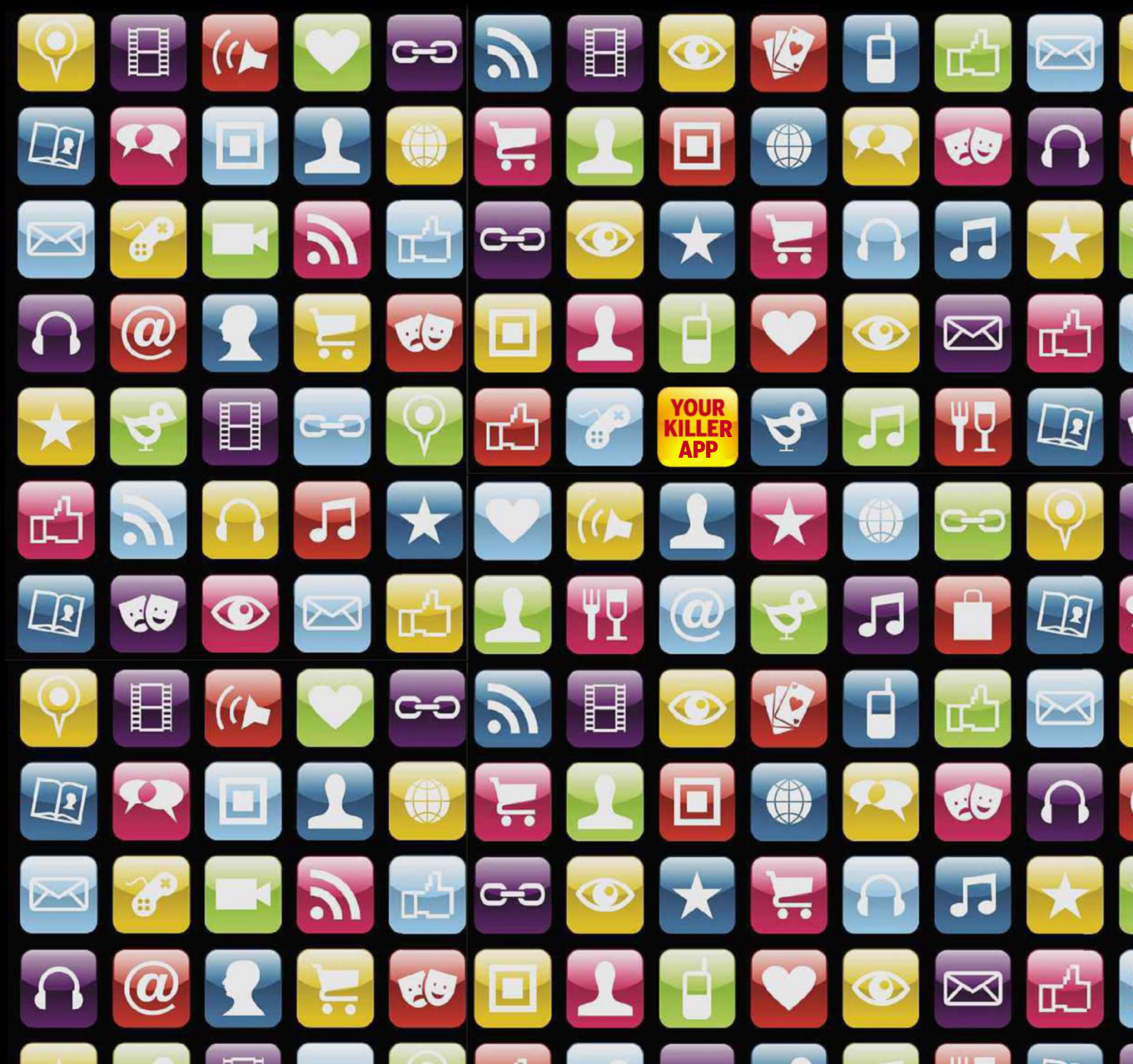


CHART-TOPPER

THE TRUTH BEHIND APP DEVELOPMENT

What differentiates an also-ran app from an all-time great? Stuart Andrews speaks to the professional app developers to find out

Is developing an app still a route to riches? Done right, and with luck, the answer remains a resounding yes. Annual app sales now account for roughly \$20 billion of revenue across the Apple and Google app stores, and Gartner predicts cumulative revenue will hit \$77 billion (£51 billion) by 2017.

Meanwhile, both Facebook and Google are hungry when it comes to acquisitions: in the past few months, we've seen Facebook buy WhatsApp for \$19 billion (£13 billion), while Google has gobbled up travel-app developer Jetpac and translation specialist Quest Visual for undisclosed sums. Undisclosed, but undoubtedly very high.

Yet the majority of app developers aren't raking it in. A 2014 Gartner report claimed that less than 1% of apps were financially successful, while Mídia Research found that only 50 companies were responsible for 81% of sales. It's a market for superstars.

This doesn't mean a new app can't be a raging success, but it takes expertise,

market knowledge, great ideas and hard graft. We spoke to a range of app developers, from freelance contractors to studios working with major brands. They told us how app development works in the real world, and what differentiates a success from another poor little orphan app.

SUCCESS VS FAILURE

So, what differentiates a successful app from one that never makes it off the starting block? For one, the original idea plays a big part. Ben Paterson is creative producer at Figure Digital, developer of the virtual pet app, Animin. "Ideas for apps are ten a penny," he said. "Everyone and their iDog down the pub has an idea for an app, and 99% of them are either rubbish, insane or completely undevelopable."

It's a view shared by Kevin King, founder of the Devon-based studio Createanet, which has a roster of successful apps that includes Temphis Availability Manager and the FA Coach's App. "You get so many 'sad birds' instead of 'angry birds' floating



around," he told us. "Because they didn't have the creativity to start with, they don't go anywhere." It's also no good trying to ape existing success stories: "We get two or three ideas a week where, once you drill down, they really just want to do Facebook. You can't take on people like that."

Successful apps are about satisfying needs, not inventing them. It doesn't matter whether that need is a way to control a hot tub from a smartphone or enable property developers to keep on top of ongoing projects; as long as the app does something users want, and does it well, it has a chance of succeeding.

PRACTICAL HURDLES

A great idea also needs to be backed up by a business case. As Chris Williams, managing director of UK app studio B60, puts it: "The first key step is to understand the business need and requirements. This is fundamental. Many apps fail because they have no real need, or the plan to make money from it isn't thought through."

Usability is just as crucial. Rob Hayward, a successful UK freelance app developer who has worked with Formula One and The Comedy Store, says you need to make it "effortlessly easy". "You've got someone's attention for a fraction of time, often a few spare seconds while they're doing something else. They want a couple of taps and everything is done."

Williams thinks that a successful app "provides the features the end user needs while keeping the interface as clear, simple and easy to use as possible". B60 pulls this off by understanding user habits mainly through a combination of in-house expertise, workflow analysis and client

consultation, although it also sees value in focus groups and end-user research.

Mobile-development studio and marketing agency Rokk Media also spends a lengthy research phase looking at potential users, sorting them into personas and following those personas on a journey through the app. "We look at what they want to achieve and what their hopes and fears might be – particularly the fears, since understanding the concerns users might have can help you point them in the right direction," said Martin Dainton, Rokk Media's chief creative officer. When developing an app for internal use by the non-technical sales team of a car dealership, for example, Rokk ensured built-in guidance and simple instructions were provided at every stage.

For Createanet, it's a question of careful prototyping, so that the key interactions are in place before a single line of code is written – and then putting usability at the core of the design. "The beauty of apps is that they're simplistic. You have to come up with an interface you can use with your thumb," explained King. "They're quite fickle. If you find something and it engages you then you're on board – and that's all about usability."

Independent developer Nick Kuh would put usability ahead of even function. "I try to keep the UI as simple and uncluttered as possible," he said. "I believe that a good app will focus on doing one thing really well rather than being feature-rich. Users are used to multitasking, so switching between apps that perform focused functions makes for a good experience in my book."

However, the biggest hurdle on the track to app success is how to stand out in such a crowded market. "My biggest obstacle these days is a saturated app store," said Kuh. "That, combined with competitors spending large advertising budgets on masses of paid-for installs, makes app store discovery very difficult."

Figure Digital's Paterson agreed, suggesting that "the biggest obstacle of all is getting the word out there and raising awareness, to find that community of users you originally had in mind and to ensure they hear

RIGHT Virtual pet app Animin is the product of thousands in investment



ABOVE Getting to the featured pages of the iOS and Google app stores is the holy grail for developers, with a huge impact on visibility and sales

THE PROCESS

All apps begin with an idea, whether it's promoting a brand or something truly groundbreaking. If you have technical skills, you might be able to develop that idea for yourself, but in most cases there'll be a need to find investment and partner with a professional developer or studio.

The development process tends to take a standard shape. First, there's a pre-production phase, which may take in conceptualisation, user research and profiling, prototyping with wireframes or mock-ups, and the nailing down of a set of features, functions, specifications and requirements. The app then goes through a design phase, where those concepts are transformed into screens, buttons, menus and displays.

At this point, development begins in earnest, as servers are set up to support any back-end functions, and the different elements and features are coded. As with most software projects, there'll be milestones, where limited alpha or beta releases or slices of the app are released internally and to the client for feedback. Bugs, issues and feedback will be spun back into development, hopefully producing a more polished and stable version 1 release.

When ready, the app is submitted to the relevant app stores. With Android, launch may be merely a few hours away. On iOS, however, you could be looking at a wait of up to two weeks as Apple vets the app. Only when Apple's gatekeepers are happy is it released, appearing on the App Store's "Featured" pages if you're lucky, or joining the endless ranks if not.



MY FAVOURITE APP

Kevin King, Createanet: "I'm proud of our work on the FA Coach's App. The customer was a nice guy who had a vision and stuck to it – and he's done well from it. Otherwise, apps are more utilities to me. I like the Spotify app, however. They had a big brief in terms of the information and features they had to deliver, but they did a great job in terms of usability."

Martin Dainton, Rokk Media: "Our Make It Yours app had a unique interface, taking the concept of a visual success map and presenting it in a form with which people could interact. I'm quite impressed by Google's Inbox at the moment. It isn't the flashiest of apps, but it makes dealing with mail so much easier. One of the nicest-looking apps I've used recently was Taasky. It flows very well. It has a great UI and it's easy to use."

Nick Kuh, independent developer: "Wordsy is a multiplayer speed Scrabble-style game I conceived about a year ago. I built the game alongside client work throughout 2014 and have enjoyed watching my family and friends become hooked. I'd also list apps that I use daily: Google Maps and Apple's Calendar app make my life easier. Instagram is a really fun way to share raucous pics with mates."

Ben Paterson, Figure Digital: "I'm immensely proud of Animin, our next-gen digital pet. As for my favourite apps – that's tough! It changes weekly, as I imagine it does for most mobile power users and hardcore gamers."

BELOW Like many independent developers, Nick Kuh works as a gun for hire, but he also develops his own apps, including Scrabble-style game Wordsy



about your app and have a chance to try it out."

How? "We have a philosophy that great content finds its users," said Paterson. "First, make something amazing. Second, find your advocates: those users who will effectively do your marketing and PR for you. Finally, continue to develop, tweak and innovate based on what these key advocates want." Nick Kuh concurs: "Focus on making apps that will retain users. Enable your users to reach out to you, and listen to their feature requests and concerns. Continue to iterate and don't give up on a good product."

Finally, as Rokk Media's Dainton explains, you need to acknowledge that the launch is the beginning, not the end. "You have to spend time marketing apps, nurturing and developing them, and when there's a new release of the operating system – particularly with Apple – you've got to update them." Not only will this keep the app fresh, but it will also ensure that Apple's habit of cycling out deprecated code doesn't leave you with an app that no longer functions.

INVESTED DEVELOPMENT

Unless you have the skills to design, code and test an app yourself, development doesn't come cheap. "Some people expect to get an app developed for £150, and they can't," said Createanet's King.

It's possible to find solo developers who will tackle a project for a few hundred pounds, he explained, but warned that the archetypal bedroom whizz-kid "might be really good at the coding, but he won't be so good at the design or the user experience side of things". King went on: "If you can't spend money on decent development, then you won't get a company that will be around in a couple of months' time to support you."

In other words, apps need a budget, which may be anywhere between a few thousand pounds and hundreds of thousands. Even freelance app developers will look at the budget as a means of separating serious prospects from those without a realistic idea of what's involved. "I get lots of enquiries," said Jason Kneen, who develops iOS and Android apps through his studio, BouncingFish. "A lot of them are rubbish, to be honest. They want to do the next WhatsApp or Instagram and usually have no clue about how the whole process works or the costs involved."

Having worked with the likes of English Heritage and Friends of the Earth, Kneen takes the ideas that interest him and sketches out the work involved, then uses that to form a ballpark budget. It's at this point that those without a solid business plan back out.

Many would-be app tycoons also underestimate the costs of the back-end

infrastructure that supports the app.

"People look sites such as Instagram and Yo, and are unaware that alongside the front-end there's back-end infrastructure in place," said Kneen. "This needs to be paid for somehow. There are cloud services that will do this for free, up to a point, but when they start charging you – when you hit a million users – you might suddenly receive a bill for \$10,000."

In addition there are design and technical challenges, from the difficulties inherent in building an app to work across multiple devices, resolutions and screen sizes, to issues concerning mobile connectivity and data flow.

Perhaps the biggest challenge in app development is time. App projects often run on short two- or three-month cycles, with immovable deadlines such as Christmas or sporting events with which to contend. "Anything is possible, within reason," said Rob Hayward. "It's just figuring out what you can achieve in the given amount of time." While there's always a temptation to add more features, app developers learn to resist. "If there weren't a limited amount of time, there wouldn't be any restrictions," Hayward said, "but when you're delivering a product in three months, then extras need to do something vital – or at least tick a box with an investor."

In a world where the changing of a single button can often result in hours of

AS LONG AS THE APP DOES SOMETHING USERS WANT, IT HAS A CHANCE OF SUCCEEDING

work, testing can be a major time sink, one that benefits from someone dedicated to the job, according to Hayward. This will not only cut down on lead times when adding new features, but could also uncover issues that developers and designers fail to spot. "You could be focused on how the design works, with different screen resolutions or languages, then a tester comes along, presses all the buttons in a different order, and finds something you wouldn't normally find."

The submission process can also lead to delays. Kneen told us how agencies often expect an app finished on Friday to go live on Monday. "I have to say that we can submit it on Monday, but it may be ten to 15 days before it can go live." Apple sometimes rejects apps for peculiar reasons, and you may need to resubmit several times before this reason becomes clear.

One way to work with the time issue is to forget about cramming every last feature into version 1, and focus instead on producing a good, stable version that you can update. "You might get to a point where you have a fully functioning app, but with two missing features that the

client wants to add," said Jason Kneen. "If they hold out they could miss a deadline, and there's no shame in having a version 1 app that does the job, then updating it two days later."

Nick Kuh agrees this can be a viable approach, with developers "creating an MVP (minimum viable product), then iterating frequent app updates as they learn from their users and improve their product over time". However, he also sounded a note of caution: "If you're launching a brand-new app based on a great idea then you want your initial offering to be polished at launch."

Why? Because it's at launch that the app might benefit from press coverage and establish a long-term position in search results, while initial reviews will be more prominent and, in Kuh's words, "more likely to sway new users". "The better you make your app for launch," he argued, "the more chance you have of long-term success. Also, submitting a great first version to the App Store gives you your best shot at getting featured by Apple – the holy grail."

THE BOTTOM LINE

Is all this effort worth it? Well, few app developers end up selling up to Facebook for several billion dollars, but all those we spoke to were sustaining a successful business. "There's plenty of work out there," said Jason Kneen, who became a full-time freelance app developer in 2011 and has been busy ever since.

"It's definitely possible to make a good living from app development if you combine the development of good indie apps with work-for-hire," agreed Nick Kuh. "I've been developing solely for iOS since 2009, and five years on I'm still inundated with iOS projects and opportunities. I pride myself on the fact that every one of my own apps has earned enough through App Store sales to pay me back for the development time that I originally invested."

What's more, there are major opportunities in the enterprise sphere. "From our point of view, the biggest growth has been in business applications," said Rokk Media's Dainton. "People are starting to see that these devices are really useful on a business level. If they have satellite teams or those going into different areas and different departments, then apps really help with productivity." It's a market Createanet is also chasing in earnest. "You might not make the next Angry Birds, but you could sell a lot of product into a 2,000-seat business," said Kevin King.

In short, the gold rush might be over, but it's still possible to make a good living from app development, and keep your hopes of building a breakthrough app alive. It won't be quick or easy, but then building a successful business rarely is. ●

WHICH PLATFORM?

According to the latest figures from app-market analyst App Annie, there are 60% more downloads from Google Play than the Apple App Store – yet the App Store makes 60% more revenue. Does that make iOS development a safer bet?

It depends. For some apps, the core purpose is to support the brand, increase online sales or support a product, in which case ignoring Android is risky. "Android has definitely caught up," said Rokk Media's Martin Dainton, "so the requirement tends to be that your app must work across the board. For some clients, this means we need to consider a framework that allows us to publish to different platforms, or they may need simply to develop different apps for those platforms."

However, as Createanet's Kevin King explains: "if you're trialling something new – a new concept or a new idea – then my recommendation would always be to build iOS first. Make sure you're completely happy with it, go through the first two or three months of development and get the bugs and usability issues ironed out. You'll then have a stable platform from which you can build in Android."

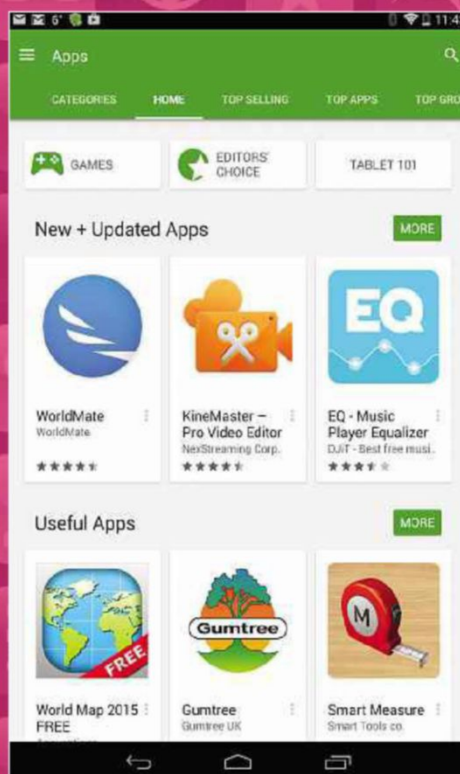
The ease with which you can go cross-platform boils down to your approach. You can code natively using Apple or Google's development tools, then port the finished app to the other platform; or you can build within a framework such as PhoneGap or Appcelerator's Titanium, so that you can compile apps that run across both.

The first approach has some key advantages. "If you're building something as a native app, then



ABOVE Despite many big-name apps now being available for Windows Phone, interest in developing for the platform is very low

BELOW Android is catching up with iOS fast – there are now 60% more app downloads from Google Play than from the Apple App Store



you definitely have more access to the device and its functionality," said Dainton. "If you're using a framework – such as PhoneGap, for example – then there'll be limitations."

The upside of using a framework is that it speeds up development and makes supporting other platforms far quicker and easier. As Titanium user Jason Kneen explained, "90% of the work that has to be done will be applicable to both platforms, and the other 10% covers whatever I have to do to get it working on the other platform, which is usually UI-related."

And what about Windows? Well, what about it? Most of the developers we spoke to said there was little to no interest in developing apps for Windows or Windows Phone. "There's just no demand," said King. "It's chicken and egg. A few top apps are now on Windows, but there's an app culture around Apple that just doesn't exist in Windows."

"Clients don't seem to be that worried about Windows," said Dainton. "We ask them if they'd like to consider it, but it often isn't on their radar." B60's Chris Williams agrees. "We have targeted Windows Phone devices, but it's rare for this to be a viable prospect due to the relatively small userbase."

Will Microsoft's unified Windows platform change this situation? Possibly – as might the growth in business-app development across tablets, phones and the desktop. At the moment, however, iOS and Android remain the focus of the app-development scene, even for those building business-focused apps.



Buffering?

Ctrl-Z your cheap internet
Ctrl-F 4D Connect

High speed / low latency
Dedicated UK team
Independent ISP
99.95% uptime



Colocation
Connectivity
Cloud

4D-PCPRO.COM



WINDOWS ANNOYANCES SOLVED

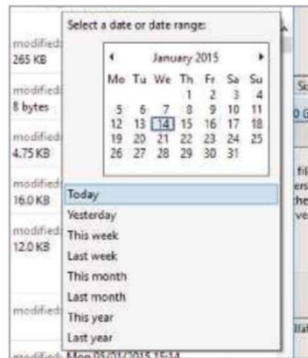
Windows is a powerful OS, but it has some infuriating quirks and gotchas. Darien Graham-Smith and Microsoft MVP Mike Halsey show you how to make it behave



How do I make Windows Search find the files I'm actually looking for?

Windows stores a database of files and folders on your hard disk, so that when you search for something, the results can be returned instantaneously. However, for speed and efficiency, only the most common file types and personal folders are included by default.

There are two ways to get Windows to search outside of your user folders: one is to open the target volume or folder in Explorer and use the search box to search directly from there. This will prompt Windows to ask if you want to add this location to its index. Alternatively, open Indexing Options from the control panel, and click the Modify button in the dialog that



appears. This will bring up a list of all searchable locations, which you can tick to add to the index.

Another challenge you might face is finding files by a property other than filenames (for example, if you want to see all images created on a certain day). You can do this by directly specifying file properties, such as "size:>250mb-" or, in our example to the left, you might type "datecreated:14/1/2015". In many cases, as you type, Windows will pop up a requester to help you select the values you want. The set of phrases that can be used to search for specific files is called the Advanced Query Syntax, and you can read more about it at pcpro.link/246aqs.

I want to reinstall Windows: where do I find my product key?

The product key used to be printed on a label on the side or underside of your PC, but on Windows 8 systems it now tends to be buried away in the operating system, or embedded in the BIOS. This isn't helpful if you suffer a system crash and need to reinstall the OS, so use a tool such as winkeyfinder.com to discover your key before you need it.

I'm seeing an extra drive in My Computer called "System Reserved". What is it?

This partition is created when you install Windows on a disk that's completely blank. It contains Windows' startup files, so you can't get rid of it – but there's nothing here that you need to access, so we suggest you simply hide it from your Computer view. Open the Disk Management Console, right-click on the drive and remove its drive letter to make it disappear.

I want to reinstall Windows without losing all my data

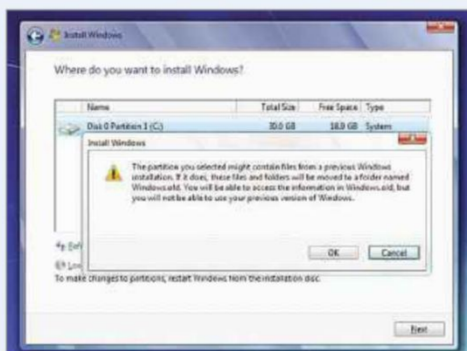
Microsoft is paranoid about people pirating Windows, so your new PC almost certainly didn't come with a disc for installing the OS. It probably came with a recovery tool, which you can use to restore the system to its fresh-from-the-box state – but this includes wiping all your personal data, so isn't a convenient solution if you simply want to declutter your system.

If you're using Windows 8, there's a simple answer. The new Refresh My PC feature restores the OS to its "naked" state without touching your data files (although you'll still need to reinstall your desktop applications). You'll find it in the Metro-style PC Settings app, under Update And Recovery.

If you're using an earlier version of Windows, the official line is to make a backup of all your data, use the manufacturer's recovery tool, then simply copy your files back afterwards. Backing up is something you ought to be doing anyway: prices are dropping on cloud storage, so even if you're currently backing up your files to an external hard disk, it's a good

idea to keep a copy off-site, just in case of disaster.

It is, however, possible to reinstall Windows "in place". To do it, you'll need to somehow get your hands on an official installation DVD, and you'll also need to find your product key (see above right). When you open the disc within Windows and select Upgrade, the installer will try to reinstall the operating system while leaving your programs and files intact; if you're trying to fix a corrupted installation, this may be all you need. If you'd rather start from a clean slate, boot from the DVD and choose the "Custom (advanced)" installation option. Follow the prompts, and install Windows on the same disk as your old OS, but do not format the disk. Once the installation is complete, your old data files will be found in a folder called C:\Windows.old.



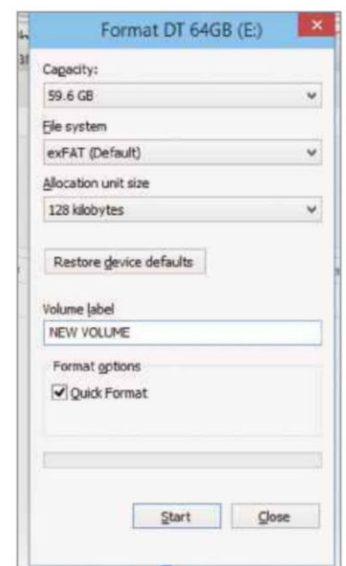
I can't write to my USB drives on a Mac or in Linux

When you format a USB drive of more than 32GB, the default option is to use NTFS, which is Windows' "native" file system. Unfortunately, while NTFS drives can be read by all major computing platforms, OS X and Linux systems can't write to these volumes without third-party software.

The simplest solution is to use the FAT32 format, which is supported across all three major platforms. If your disk is larger than 32GB, the Windows Format requester won't show FAT32 as an option, but you can format a disk with this file system from the command prompt by typing "format d: /fs:fat32 /q" – where d: is the letter of your removable drive. The /q parameter specifies a quick format, which means Windows won't spend time checking the drive for errors.

FAT32 has one limitation: individual files can't exceed 4GB, which could be a problem if – for example – you're planning to move huge videos or database files

around. In this case, you should choose the exFAT file system: this raises the maximum file size to 16 billion gigabytes. exFAT is only supported on Windows Vista and later, however, and on OS X 10.6.5 (Snow Leopard) or later.



Some of our tips for solving Windows annoyances involve installing third-party software, editing the Registry and even reinstalling Windows. Always make a backup before embarking on any operation that might endanger the wellbeing of your PC – we can't be held responsible if something goes wrong!





My PC takes forever to shut down and restart

This shouldn't be a problem for Windows 8 users, as Microsoft has completely revamped the way the OS shuts down and restarts. Parts of the OS are hibernated, rather than being completely shut down, and the result is a restart cycle that typically takes less than 20 seconds.

However, those on older versions of Windows have to wait for all programs and services to shut down before the computer switches off, which can be a slow process. By default, Windows 7 gives programs that are running 12 seconds to close down cleanly before attempting to force them to shut down.

There are two ways to speed up this process: one is simply to close programs yourself as you finish using them, so that there's less waiting around when the time comes to shut down the PC. This also saves resources, so you might see a performance benefit too.

If this still isn't fast enough, you can edit the Registry to shorten the 12-second timeout. Open the Registry editor – and make a backup of your Registry just in case – then navigate to HKEY_CURRENT_USER\Control Panel\Desktop, create a new DWORD value called “AutoEndTasks” and set its value to “1”. Then, find HKEY_CURRENT_USER\Control Panel\Desktop\WaitToKillAppTimeout and give it a value of “2000”. This is in milliseconds, so this setting will cause programs to be automatically closed after two seconds. Remember that forcing programs to close early can result in lost data, as files might not be saved.

What about the other side of the equation – making Windows start up more quickly? Defragmenting your hard disk may help, but it's unlikely to save you more than a few seconds; on an SSD, it won't have any effect at all, since all flash cells take the same time to access, regardless of their physical location.



Instead, try running the third-party BootRacer tool (greatis.com/bootracer), which is free for non-commercial use. This tool tracks Windows activity during startup, and can tell you which programs and processes are taking the most time, so you can identify what you may want to remove or prevent from running automatically.

Can I mute my PC when idle so it doesn't keep making noises while I'm in the other room?

There isn't a simple setting for this in Windows, but it can be done with third-party software. NirCmd lets you mute and unmute Windows audio from the command line (pccpro.link/246nircmd); you can use the Windows Task Scheduler to call this automatically at times when the computer is idle. In Windows 8, you can also silence notifications for up to eight hours by opening the Settings charm and clicking Notifications – or set up recurrent Quiet Hours within PC Settings | Search & Apps | Notifications.

I can't install Windows 8.1 with my Windows 8 product key

For some reason, Windows 8.1 uses different product keys to Windows 8, so if you want to reinstall, the official recommendation is to use the Windows 8 installer, then upgrade to Windows 8.1 through Windows Update and the Store. However, it is possible to trick the installer into installing Windows 8.1 with a Windows 8 key: see pccpro.link/246win81 for a step-by-step guide.

My music library is full of files with names such as “ALBUMART_{E6043A1C-BBEB-49C5-B3F0-5259B6312C34}_LARGE.JPG” – how do I get rid of them?

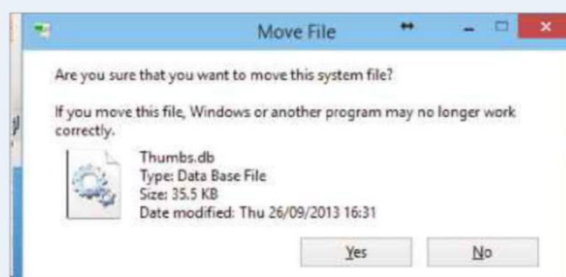
These are the thumbnail art files for your music tracks; they're downloaded by Windows Media Player on all recent versions of Windows, and they're usually hidden, so there isn't normally a need to get rid of them. The bad news is that, at present, there's no way to stop Windows Media Player from creating these files (disabling “Retrieve additional information from the internet” ought to do it, but doesn't). Pending a new version of the software, the best course of action would be to switch to a different media player.

I'm seeing an “Unknown device” in Device Manager. How do I work out what it is?

First, make sure you've downloaded and installed all the drivers available from the manufacturers of your PC, components and peripherals. If the device still can't be identified, open its Properties panel, select the Details tab

and select Hardware IDs from the dropdown menu. You should see a string similar to “PCI\VEN_10EC&DEV_8168&CC_0200”. A web search for the vendor code (“VEN_10EC” in this case) should tell you the manufacturer, and searching for the device code (“DEV_8168”) may well lead you to the specific device.

Are you sure that you want to move this system file?



THUMBS.DB file that stores previews of the images in a folder, or the FOLDER.INI file that contains various view settings. It's safe to move these files, or to delete them in the course of removing an unwanted folder. Unfortunately, there's no way to disable the warnings that will pop

It's maddening when you're trying to move a folder from one place to another – or delete it – and Windows stops mid-action to pop up a requester asking you to confirm that you want to move one particular file. It's even more annoying if you've gone off to do something else, and come back to find that Windows has been sitting idle for an hour, rather than getting on with the task at hand.

In some cases, you should heed the warning. Files are generally flagged as “system files” for a reason, and moving them around can cause OS and application functions to fail when they can no longer find the resources they need.

Often, though, the file in question is something perfectly innocuous – such as the

up when you try to do so.

If you want to rid yourself of this annoyance, you'll need to resort to a third-party trick. If you're adept with scripting hosts such as AutoHotKey or AutoIt, you could write a script that looks out for this particular requester, and automatically hits the “Yes” button whenever it pops up. Alternatively, check out a program called PTFB Pro (ptfbpro.com), which lets you set up all sorts of automatic behaviours and shortcuts such as this – the name stands for “Push The Freakin' Button”. Of course, when setting up a system that's deliberately intended to defeat Windows' built-in protections, you should be extremely careful, as a misstep could have disastrous results!

Group Policy Editor seems to be missing from my PC

Only the Professional and Enterprise editions of Windows include the Group Policy Editor; there's no officially supported way to install it on Home editions. However, if there's a particular template you want to apply, you may be able to achieve the same thing by editing the Registry directly: see [pcpro.link/246gpedit](#) for a long table of Group Policy objects and the Registry keys they control.

Help! My screen has turned upside down!

You've accidentally activated Australian regional settings. Press Ctrl+Alt+Up Arrow to restore the regular orientation. If that doesn't work, look for rotation options in your graphics driver.

I can't connect to my PC remotely because it keeps going to sleep or hibernating

You can disable sleep and hibernation from within the Power Options in the control panel. Alternatively, many systems can be configured to wake automatically when an incoming network connection is detected: to check this is enabled, open Device Manager, then open the Properties page for your network controller, click on the Power Management tab and enable "Allow this device to wake the computer". Note that you may still need to configure your router and remote access software to enable Wake-on-LAN for this system.

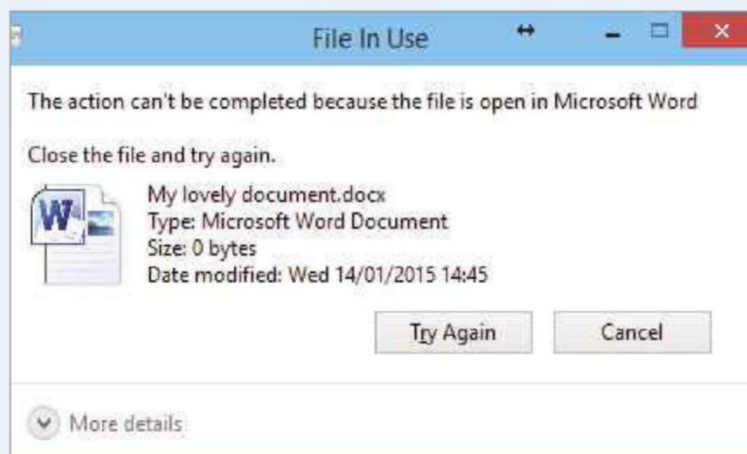
Can I automatically switch my default printer when I move between home and the office?

Open Devices And Printers from the control panel and click on any printer. Then select Manage Default Printers from the toolbar; from here you can set up different default printers for different networks.

I did something and now Windows 8 won't start. How do I get into Safe Mode?

Can you create a Recovery Drive on another Windows 8 PC, or boot from your install DVD? If so, you should be able to get to the Advanced Repair Options: from here, click Troubleshoot, then Advanced Options, then Windows Startup Settings to find Safe Mode.

The action can't be completed, as the folder/file is open in another program



When a file is in use by a program or process on your PC, Windows locks it so that no other process can modify it. You may be able to open multiple instances of the file, but actions such as moving or deleting won't be permitted, as this may result in a crash or in data loss.

Unfortunately, sometimes Windows Explorer, or some invisible background process, fails to release its handle on a file after it's been accessed. In this case, even though you're no longer actively using the file, it still can't be moved, deleted or renamed.

The simplest way round this is to restart the PC, which will clear all locks. If that's too drastic, you can also try opening the Task Manager and restarting Windows Explorer.

For a more targeted approach, try out the freeware Unlocker tool from [emptyloop.com/unlocker](#) – this adds a right-click menu option to Windows Explorer that will attempt to release any locks on the selected file.

If you want to know more about what's locking your files in the first place, download Process Explorer from [sysinternals.com](#); run the software, then select File | Show Details For All Processes. Next, open the Find menu and click "Find handle or DLL". Search for the name of the locked file and select it in the search results. You'll then see it appear in the details box at the bottom of the Process Explorer window; you can release the lock by right-clicking and selecting Close Handle.

Docking or waking my PC causes icons and windows to rearrange

This is an issue we've faced ourselves, on a PC connected to a 4K display by a DisplayPort cable. In our case, when the screen wakes up from sleep, it takes a moment for Windows to correctly re-identify the monitor resolution. While that's happening the OS momentarily falls back to the default 1,024 x 768 resolution, so all open windows are shuffled up to fit the smaller desktop. Once the proper resolution is detected, the desktop switches back to the correct resolution – but now everything is left bunched up at the top-left corner of the screen.

The likely cause is an issue with the graphics driver, so if you're having similar problems, the first step is to check whether an updated driver is available that might fix the problem.

If you have a graphics driver utility such as the AMD Catalyst Control Center or Nvidia Control Panel, it's also worth checking the settings here, as something could be misconfigured. If you have multiple monitors connected, running both screens at the same resolution may help.

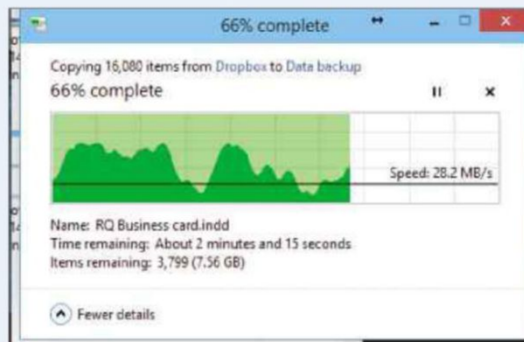


When I'm copying files, the "time remaining..." indicator keeps switching from two minutes to a couple of days and then back again

In fairness, Windows is doing its best. To provide any sort of estimate, the operating system has to extrapolate from the observed transfer speed. At first, it has to rely on the speeds achieved during the first few seconds of the copy operation.

This speed can easily change, however. If, while copying, you're also performing another action – such as loading a program or watching a video – your copy operation might briefly stall, causing Windows to drastically revise its timing estimate.

Even if the computer is otherwise idle, there are plenty of factors that can affect copying speed. For example, writing lots of small files tends to be much slower than one big one. If a



mechanical disk is becoming full, fragmentation could cause the second half of a large file to write

more slowly than the first half. If you're copying files over a network, interference could have a similar effect. And so on.

There's no true reliable way to get better estimates: a cynic might suspect that the reason Microsoft added the speed graph to the Windows 8 file-copy progress window was so that you could see for yourself just how unpredictable data rates are.

If you want your copy operations to complete as quickly as possible, your best bet is simply to minimise the number of other things going on. You can also use software such as TeraCopy (codesector.com/teracopy), which uses memory buffers to speed up file copying where possible.

Why do I have to log in every time I turn on my PC?

The obvious answer is for security – and if you're at work, or on a laptop containing personal or confidential information, we suggest you leave these password prompts enabled. Data theft is a growing threat, so requiring re-authentication whenever your PC wakes up is a good thing. If you have young children who might be tempted to meddle, a wake-up password can help there too.

For a home PC, however, you might understandably want to skip the password. To disable the password request when Windows wakes up from sleep, right-click on the desktop and select Personalise. Next, click the Screen Saver link and you'll see a tickbox labelled "On log-on, display log-on screen". Untick this and in future your PC will spring straight back into the desktop.

If you don't want to be asked for a password even when you start up Windows, this too can be configured, although the option is



slightly more hidden away. Search for netplwiz at the Start menu or Start screen, and open the applet that appears. This will show a selection of master settings for all user accounts on the PC, one of which is "Users must enter a username and password to use this computer". Untick this option – and enter your password one last time to authenticate – and the selected user will henceforth be automatically logged on whenever Windows starts up.

Where has all my hard disk space gone?

Installing OS and application updates can result in large caches of backed up files you don't need. Applications can also leave temporary files on your disk in places that aren't obvious. Run Windows' built-in

Disk Clean-Up tool and you may be surprised at how much can be safely junked. If you still can't account for all your hard disk space, try WinDirStat (windirstat.info), a graphical tool that scans your hard disk and shows you the heaviest files and folders at a glance.

Windows Update keeps turning itself back on!

It goes without saying that, in most cases, Windows Update should be left on. And to be precise, it isn't normally Windows Update itself that causes frustration, but the way it insists

on restarting your PC at inconvenient times. The simplest solution to this is to open Windows Update from the control panel, click "Change settings" in the left of the window and change the dropdown option to "Download updates, but let me choose when to install them". You'll still be nagged when updates are available, but you'll be able to install them and reboot at your own convenience.

If you want to prevent Windows Update from restarting your PC altogether, open Regedit and navigate to HKEY_LOCAL_MACHINE\SOFTWARE\Policies\Microsoft\Windows\WindowsUpdate\AU. If this key doesn't exist, you can create it. Create a DWORD called "NoAutoRebootWithLoggedOnUsers" and give it the value "1". This will tell Windows to stop automatically restarting your PC: updates will now only be installed when you restart the PC yourself.

If you never want to download updates – for example, if you're a developer testing against a specific OS component – you can disable Windows Update from the control panel, but be warned: you'll still have to keep an eye on your settings, as Microsoft has a sneaky habit of re-enabling Windows Update whenever it gets a chance, such as when you install new software or change settings for Office or Internet Explorer.



Mike Halsey is a Microsoft MVP and the author of *Troubleshooting Windows 7 Inside Out* and *Troubleshoot and Optimize Windows 8 Inside Out* from Microsoft Press. He's also the author of *Windows 10 Troubleshooting* and a new series of short guides to subjects such as the Registry and software compatibility, to be released this spring from Apress. Find him on Facebook and Twitter as [PCSupportTV](#).



However you build it...

YOUR WEBSITE DESERVES GREAT WEB HOSTING

The UK's best web hosting backed by 24x7 UK Support

USING HAND CRAFTED HTML & CSS

WEB HOSTING

- ✓ Award-winning hosting
- ✓ No space or data limits
- ✓ Host multiple websites
- ✓ Cloud hosting architecture
- ✓ Linux & Windows available

USING A CONTENT MANAGEMENT SYSTEM

WORDPRESS

- ✓ Free with our web hosting
- ✓ Easy one-click set up
- ✓ 70+ one-click apps
- ✓ Joomla!, Drupal, Magento & more
- ✓ Save time with unlimited installs

USING A WEBSITE BUILDER

SITEDESIGNER

- ✓ Create beautiful web sites, no code
- ✓ Easy drag & drop design
- ✓ Fully hosted solution
- ✓ Customise every pixel
- ✓ 100+ designs or create your own

✓ DOMAIN NAMES ONLY £2.99

✓ 30 DAY MONEY BACK GUARANTEE

✓ FREE 24x7 UK Support

Find out more www.heartinternet.uk

Call us now 0330 660 0255

Prices exclude VAT.

SUBSCRIBE NOW!



Subscribe to **PC PRO** today and save on the single issue price.

Each issue of **PC Pro** will be delivered directly to your device each month.

SEE NEXT PAGE FOR SET-UP INSTRUCTIONS

▶ HOW TO SUBSCRIBE...

...on an iPad or iPhone

- STEP 1** Return to the **PC Pro library**
- STEP 2** Choose your subscription term and tap twice on the 'price' box
- STEP 3** Choose whether to create an optional **PixelMags** account
- STEP 4** Enter your **Apple ID password** to confirm



...Windows 8

- STEP 1** Return to the **PC Pro library**
- STEP 2** Choose a subscription term from the bottom left menu and click/tap the corresponding 'Purchase' button
- STEP 3** Click **buy** on the popup bar
- STEP 4** Enter your **Microsoft account details** to confirm



...on an Android device

- STEP 1** Open the Google Play Store **homepage** and navigate to the **Newsstand** section using the tabs at the top
- STEP 2** Search for **PC Pro** using the search icon in the top right of the screen
- STEP 3** Click the 'Subscribe' button and pick your term
- STEP 4** Enter your **Google password** to confirm



...via the app

- STEP 1** Search for **PC Pro** via the search box in the **Shop tab**
- STEP 2** Tap the 'Subscribe' button
- STEP 3** Choose whether to create an optional  account
- STEP 4** Enter your **Apple ID password** to confirm



**Subscribe to PC Pro today and save
on the single issue price**

Reviews

The biggest, best, most exciting products in tech – tested, evaluated and reviewed



Samsung Gear VR

A real eye-opener, but it's still early days for consumer-grade virtual reality

SCORE ★★★★★

PRICE £158 (£190 inc VAT), pre-order from clove.co.uk (pcpro.link/246gearvr)

The concept of virtual reality has arguably been around for as long as computers themselves – but a really persuasive implementation has always seemed

frustratingly out of reach. Now, though, a host of companies are introducing new technologies that promise to immerse you into the digital world, and the Gear VR is the first fully realised product of this new generation.

For such a pioneering product, the Gear VR makes an unassuming first impression. It's made entirely of white plastic, and has the appearance of a

rather bulky pair of ski goggles. You may also be surprised to find that the Gear VR lacks a display of its own: similarly to Google's Cardboard concept, it works in conjunction with a Galaxy Note 4 smartphone, which clips on at the front of the headset. Internal lenses then focus your vision onto specific areas of the screen.

Controls are minimal: a wheel on top of the headset adjusts the focus,

and there's a pair of volume buttons on the right, alongside a capacitive touchpad and a back button. A sensor inside the goggles detects when you've removed them and turns off the screen, and a standalone gamepad is available for an extra £30.

How it works

While the Gear VR looks fairly basic from the outside, as soon as you don the headset you'll realise a lot of clever work has gone into it. Using a series of gyroscopes - technology licensed from Oculus VR, the Facebook-owned organisation behind the much-hyped Oculus Rift headset - the Gear VR tracks your head movements in real-time, providing a seamless and completely immersive VR experience.

To see just how good it is, you only have to play with one of the supplied 360-degree apps. Our first try was with The Blu VR, an educational "video" that flies you through a seascape, allowing you to look around freely as you go. The experience of following a killer whale as it drifts along, or a shark as it swims past, is enough to convince us this technology is here to stay. Anything that can cause PC Pro's normally articulate editor-in-chief Tim Danton to blurt out "that's amazing" like a hormonal teenager has to be pretty good.

This isn't where the Gear VR's talents end, either. It's possible to play games, view static (but immersive) 360-degree photographs, and even watch standard 3D and 2D movies via the Oculus Cinema app. The latter isn't as daft as it sounds: the app places you in a virtual seat in a virtual cinema, allowing you to watch the movie as comfortably as you'd expect. Since the screen doesn't follow your gaze as you glance around, it's completely convincing, and the viewing experience feels remarkably natural.

Some of this content is supplied on a microSD card, which comes with the headset, and you can download further apps, games, photos and videos from the Gear VR's store app. Not all of it is inspiring, though: Milk VR's 360-degree videos are effective but rather boring, while the games are mostly lightweight "look, shoot and explore" affairs. One of the more developed offerings is Temple Run VR: this looks great, but after five minutes of running and jumping through its virtual world we were reaching for the sick bucket. Perhaps not all games are suitable for the full VR treatment.

Such issues aside, there's enough here to provide a tantalising insight



ABOVE The Gear VR splits the Note 4's screen into two sections, one for each eye

"The experience of following a killer whale as it drifts along is enough to convince us that this technology is here to stay"



ABOVE The Gear VR requires a Samsung Galaxy Note 4 to work; this clips in neatly at the front

- + A truly immersive VR experience that's simple to use and reasonably priced
- Only works with a Note 4, and the content is superficial

into what future VR content might look like. A more developed version of The Blu VR, for instance, would be a revelation in an educational environment. With the ability to pause the action, zoom in on a particular creature and launch a floating information panel, it could create a

new genre of immersive pedagogic tools.

The cinema is another taster of things to come: why sully your minimalist designer living room with a huge 100in telly, when all you really need for the home-theatre experience is a Gear VR strapped to your noggin and a pair of decent headphones?

Our only caveat here is that, for now, the image isn't sharp enough. The Note 4's 2,560 x 1,440 screen resolution is exceptionally high by smartphone standards, but split it into two and stare at it from an inch away and grain is clearly visible, especially around the edges of text, buttons and graphics. Still, in time, as

the pixel density of LCD panels rises inexorably, we can see VR becoming a genuine alternative to static TVs and projectors for big-screen viewing.

Verdict

It's clear that the Gear VR is an early-adopter device. The fact that it can only be used with one type of smartphone inevitably limits its appeal, and any consumer VR system hoping to win over the mass market will need a more developed content library than what's currently on offer - not to mention a sharper resolution.

We must also mention some specific niggly problems with the Samsung hardware. Sometimes we struggled to position the headset so our eyes could focus comfortably on the display (mounting the goggles high up on your face seems to provide the best results), and since there's little ventilation, the lenses tend to fog up in use, ruining the effect.

Overall, though, the Samsung Gear VR is a fabulous piece of kit. It's a truly impressive technical achievement, good enough to convince us that within a couple of generations virtual reality will be a true mainstream technology. And for now, it's an exciting glimpse of the future - one that, if you're curious, and happen to own the right phone, can be yours for a mere £190. **JONATHAN BRAY**





Windows 10: the next chapter

Microsoft's new OS is taking shape nicely, and the latest build is packed with new things to play with

PRICE Free, available now from insider.windows.com (pcpro. link/246windows10)

Microsoft's Next Chapter event (see p10) brought a new preview build of Windows 10, allowing members of the Insider Programme to see how the OS is taking shape. The Project Spartan browser is notably absent – evidently it isn't ready for a public debut yet – but there's plenty else to see in terms of tweaks and new features.

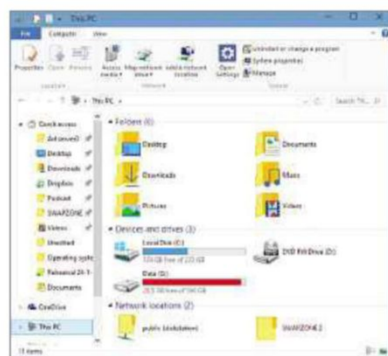
Cleaner looks

On installing Build 9926, you'll spot a few visual changes. The taskbar icons have shrunk, making it easier to see the underline effect that shows which applications are open. Explorer windows gain a cleaner look, with simpler minimise, maximise and close icons, as well as more minimal back and forward buttons.

Tablet-style apps and PC Settings (now just called Settings) pick up on the same theme, as does a new beta release of the Store app. Both sport tasteful redesigns that make use of familiar elements such as tabs and icons; writing on the Windows blog, Insider boss Gabe Aul described this as "a new visual design, which will be common across PCs, tablets, phones and the web", and it's definitely a step forward from the garish, unstructured look of Windows 8.

Not all the aesthetic changes are a success, however. The new folder icons in Explorer are ugly, and while it's clever that recently accessed folders now add themselves to the quick-access list in the Navigation pane automatically, the big, grey icons that indicate pinned items here are hardly elegant.

One more major upgrade to the front-end comes in the shape of the Notifications panel. Previously, this



ABOVE The Start menu now scrolls, and optionally expands into a full-screen interface

LEFT The Windows 10 Explorer has a new look, with cleaner icons and brightly coloured folder icons

was a bare box listing recent pop-ups, but it's grown into a proper sidebar, with entries neatly shown in either grey or black to indicate with which you can interact. At the bottom sit quick-access buttons for various settings, switching into tablet mode or quickly connecting to Bluetooth audio devices and Miracast displays. It's a coherent replacement for the multiple sidebars of Windows 8.

I started something

At first glance, the Start menu looks much like that of previous builds, with application icons at the left and tiles at the right. However,

rather than expanding sideways as you pin tiles and apps, the menu now keeps a consistent width and scrolls up and down – a far more manageable arrangement.

Search behaviour has become a bit muddled, however. You can still hit the Windows key and type to locate applications, documents or online resources – but to reflect the idea that all searches now go through Cortana (see *Hey, Cortana*, right), your results now pop up from the search field and sit awkwardly over the top of the Start menu. For a neater experience, you can press Windows+S to access the search box directly, but we preferred the way Start and search used to work together seamlessly.

Windows 10 on a tablet

One final update to the Start menu is a new toggle that expands the tile-based interface into full-screen mode. This view replaces the old Start screen: rather than switching between two different launchers, you now get only one menu that scales up and down to suit either desktop or tablet use. It's an eminently sensible way to accommodate different usages: the only question is why Windows 8 didn't do this in the first place.

The other big change for tablet users is the quiet removal of the charms bar: swipe in from the right and you now get the Notifications sidebar instead. Frankly, we're happy about this – the charms were never a particularly quick or intuitive way to get things done. Similarly, Modern apps – as Windows 10 still calls them – now offer a streamlined set of controls in windowed mode, with a proddable button to switch to full-screen view at any time.

Once again, the only letdown is search. In tablet mode, the onscreen keyboard squeezes the results box into a tiny space, restricting the number of visible results and making them fiddly to select. We hope Microsoft keeps working on this aspect of things ahead of the final release.

Smartphones and Xbox

Windows 10 isn't just about PCs and tablets. It's coming for smartphones too, with a new look and feel to match the desktop OS, and support for the new universal app framework, which allows Modern apps to run on both phone and desktop devices. As with the desktop platform, Microsoft plans to release a preview smartphone build to the public in the coming months – suggesting that the final release might come as an upgrade for current Windows Phone 8.1 users.

Interestingly, Windows 10 also integrates with the Xbox One console: a bundled app lets you access your

Hey, Cortana

The latest build of Windows 10 includes the desktop debut of Microsoft's "personal digital assistant", Cortana. Officially the feature is, for now, US-only, but you can enable it in the UK by changing your region and keyboard settings. Without the Spartan browser – which Cortana uses to learn about you and make browsing suggestions – there's a limit to her usefulness, but you can still get a taster of the idea.

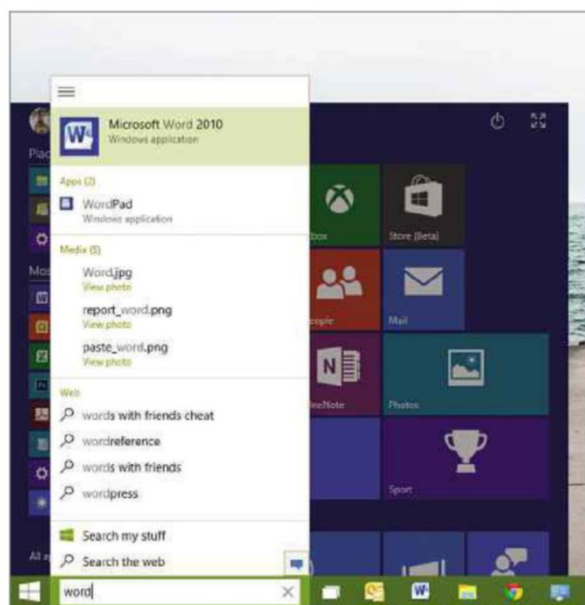
You can access Cortana by typing queries into the taskbar search field, but the real focus is on voice commands, which you can issue by clicking the microphone icon – or, in the optional always-listening mode, by using the key phrase "Hey, Cortana". You can carry out web searches, search for documents (using the somewhat unintuitive "show me" phrase), ask about a variety of topics – from the weather forecast to facts such as "What's the longest bridge in the world?" – and set reminders. At present, however, you can't use voice to create appointments or take notes.

Unfortunately, the speech interface is patchy. The "Hey, Cortana" key phrase isn't always registered, and when it is, Cortana sometimes doesn't listen for long

enough, resulting in half-recognised questions. Another problem is the quality of Cortana's voice recognition, which simply isn't as accurate or reliable as Apple's or Google's. It's particularly weak at recognising names and other non-dictionary words, which can make searching the web infuriating. Overall, we can see Cortana's potential as a rival to Google Now and Siri, but there's a lot of work to be done if it's to become a really useful and usable part of Windows.



LEFT The updated Settings app provides another look at Microsoft's ideas for a cleaner aesthetic



BELOW Pressing Windows and then typing to search results in an ugly collision of interfaces

Xbox friends list, achievements, activities and so forth, and in the final release it will also be possible to stream games from the console to any Windows 10 device. The console itself, meanwhile, will be able to run universal apps – part of a clever joined-up strategy to attract developers to the Windows Store by growing the potential market.

Verdict

This latest build shows Windows 10 starting to develop a personality of its own. Not everything is fully realised, but the new OS no longer feels like an iteration of Windows 8 – at this point it's more like the antidote to that OS, pulling off a genuinely harmonious marriage of desktop and touch-operation modes, while managing to remain fluid and intuitive in both.

Which is just as well, since this latest build of Windows 10 carries particular significance: it's the first to emerge since Microsoft announced that upgrades within the first year of the official launch will be free for users of Windows 7 and 8 (excluding Enterprise versions). That means a lot of previously ambivalent customers will suddenly be eyeing up Windows 10 as their next OS. To an extent, Microsoft's fate hinges on whether or not they like what they see. Happily, the signs are that development is continuing down the right track to win back those hearts and minds. **DARIEN GRAHAM-SMITH**



HP Envy x2 13

HP takes on the Surface Pro 3 with its Core M-powered tablet, but can it compete with Microsoft's design?

SCORE ★★★★★

PRICE £520 (£650 inc VAT) from
johnlewis.com (pcpro.link/246envy)

If you can't beat them, join them. That appears to be the mantra for HP with its new Envy x2 13. Where the previous Envy x2 partnered an 11.6in tablet with a keyboard dock, 2015 sees it grow into a larger 13.3in model replete with a built-in kickstand and a thin, clip-on keyboard; a design clearly inspired by the Microsoft Surface Pro 3.

If you're hoping to be bowled over by a futuristic, super-svelte hybrid, however, we suggest you look away now – this simply isn't what you've been waiting for. The main problem is that it's far too big, especially given that it's powered by one of Intel's latest Core M processors, purpose-built for thin-and-light devices.

In fairness, the Envy x2 isn't a horribly ugly thing, but HP has made some truly baffling decisions in the design department. For starters, the pair of Beats-branded speakers take up a couple of centimetres at each side of the display, and the thick bezels at the top and bottom mean that with the keyboard attached the Envy x2 is as wide and tall as most 15.6in laptops. It positively dwarfs the Surface Pro 3 and, at 14mm thick, it's never going to win the award for slimmest Windows tablet, either.

It's difficult to handle, too. The tablet alone weighs 1.27kg, and the only real plus point of this is that the silver metal body feels pleasingly solid in the hand. But the build is too hefty for a tablet: unless you're a regular at the World's Strongest Man (or Woman) competition, this isn't a device you can hold comfortably in

one hand. The presence of a sturdy, fold-out kickstand at the rear does help a little, though: it's easy to prop up the HP on a flat surface, and since it folds right back to almost flat, it's comfortable to use in tablet mode whether on a lap or a desk.

Thanks to the layer of fetching grey fabric on its underside, the clip-on Bluetooth keyboard looks smart. This clasps magnetically to the tablet and folds against the display when you need to pop it in a bag, with strong, hidden magnets holding it firmly in place. A loop along the keyboard's edge hints at stylus support, but this is a £32 optional extra. Sadly, the keyboard doesn't have a reserve battery for keeping the tablet topped up – instead, it draws its power from the tablet.

The keyboard itself is pretty good. We're not fans of the vertical strip of Page Up, Page Down, Home and End buttons on the far-right edge – the arrangement makes it far too easy to press these buttons by mistake – but the widely spaced backlit keys provide just the right amount of feedback, and the soft-leather wristrest makes for comfy typing. The touchpad, however, made us thankful of the touchscreen; it's far too sensitive to taps, yet feels oddly laggy and unresponsive to cursor movements, and it often registered left-clicks when we were simply trying to scroll the mouse cursor across the screen.

ABOVE The Envy x2 13's design appears to have been inspired by the Microsoft Surface Pro 3

"Unless you're a regular at the World's Strongest Man (or Woman), this isn't a tablet you can hold comfortably in one hand"

ABOVE The fold-out kickstand provides a good range of movement

We can only hope that a driver update improves matters.

Otherwise, the Envy x2 suffers from several of the same usability issues as Microsoft's Surface Pro 3 tablets. The x2 is fine on a desk: the kickstand provides an excellent range of movement, and the large keyboard

and screen make for a workable substitute to a laptop. However, things go downhill rapidly once you try to use the Envy x2 elsewhere. The heavy tablet and lightweight keyboard make for an unstable combination on your lap, and the sheer size of the Envy x2 makes it a poor travelling companion.

There are glimmers of quality here and there. The Envy x2's display is great. This stretches a Full HD resolution across a 13in IPS panel, and it bursts with dynamic, punchy images. Brightness tops out at



BATTERY: light use, 9hrs 12mins



REAL WORLD BENCHMARKS

3.4GHz Intel Core i7-2600K, 4GB DDR3 = 1

OVERALL 0.59



392cd/m², contrast reaches 1,095:1, and the panel covers a respectable 93% of the sRGB colour gamut. It's by far the HP's strongest suit.

Behind the scenes, Intel's Core M-5Y10 CPU provides the Envy x2's processing power, a chip that sounds rather frugal on paper. It runs at a base frequency of only 800MHz, boosts up to 2GHz and has a TDP of a mere 4.5W. In truth, we were primed for disappointment, after the faster-clocked Core M-5Y70 in the Lenovo Yoga 3 Pro turned in some very mediocre numbers.

Happily, the x2 confounded our expectations. In our Real World Benchmarks, the combination of the Core M, 4GB of memory and 128GB SSD turned in an Overall score of 0.59, which is well ahead of the Yoga 3 Pro's 0.45, and not far off the performance of Ultrabooks and rival hybrids with Core i5 Haswell hardware. It's clear that, with the right hardware design, Intel's Core M has a surprisingly healthy performance kick. What's more, the fanless design means there isn't a whisper of noise, even when the Envy x2 is working flat out.

Battery life is limited more by the demands of the Envy x2's display than the power-frugal CPU, but the HP acquitted itself reasonably well in our tests. With the display brightness set to 120cd/m², our looping-video test saw the Envy x2 chew through its capacity in a reasonable 6hrs 8mins. We had been hoping for more, however: given the Core M CPU, this is by no means a record-breaking performance.

The Envy x2 wants for little when it comes to connectivity. There are two full-sized USB 3 ports, one on either edge of the tablet, a full-sized HDMI output and a microSD slot. Speedy 802.11ac wireless networking is the order of the day, and Bluetooth 4 is included as well. The front-facing 2-megapixel webcam isn't stunning, but there's detail enough for video chats over Skype.

The final disappointment here is the Envy x2's speakers: although they take up a sizable chunk of space either side of the display, sound quality is middle of the road. There's plenty of volume, and enough energy to make music and movie soundtracks listenable, but there's a harsh quality to the sound that made several of our test tracks sound edgy and thin, and the lack of low-end and mid-range warmth sees basslines almost disappear. We expected far better.

After a few days with the Envy x2, we kept returning to one question: what is it actually good

+ Bright display, good performance and keen pricing

- Middling battery life, annoying touchpad and far too heavy

RIGHT The heavy tablet and lightweight keyboard make for an unstable combination on your lap

at? It's too big and unwieldy for a tablet we'd want to use with any regularity, and the clip-on keyboard is borderline impossible to use on your lap, or in most situations when you're travelling. The Envy x2 is most at home when it's sitting on a desk, but even in this scenario we found the touchpad to be a regular aggravation.

It's a shame, because the excellent display and solid performance tick two important boxes, and the £650 price is a huge plus point. The Surface Pro 3 is pricier at £849, and that's without the keyboard. Despite the keen pricing, though, the HP's flaws

make it impossible to recommend; for a device that promises the best of both worlds, the Envy x2 delivers neither.

SASHA MULLER

SPECIFICATIONS

800MHz Intel Core M-5Y10 • 4GB RAM • 128GB SSD • 13.3in 1,920 x 1,080 touchscreen • 2 x USB 3, HDMI • 802.11ac Wi-Fi • Bluetooth 4 • Windows 8.1 64-bit • 1yr RTB warranty • 355 x 216 x 14mm (WDH) • 1.27kg (1.83kg with keyboard)



BELOW With the keyboard attached, the Envy x2 is as wide and tall as a 15.6in laptop



Broadwell: need to know

The Core M processor inside the Envy x2 is one of the first chips we've seen based on Intel's new Broadwell microarchitecture – but it will soon be joined by a new family of fifth-generation mobile Core i3, i5 and i7 processors. Broadwell desktop chips aren't due until this summer, but anyone using a Haswell laptop right now is about to find themselves running last-generation hardware.

Does this mean your current laptop is obsolete? Absolutely not. According to Intel's "Tick-Tock" model, Broadwell is a "Tick" – a scaling down of a previous architecture, rather than a new one. Specifically, Broadwell uses the same CPU core as Haswell, but shrunk from a 22nm manufacturing process to 14nm. This brings a minor performance benefit: smaller chips generate less heat, so they can spend more time running at "Turbo Boost" frequencies before they need to slow down and cool off. But the practical effect is small: Intel's own marketing material anticipates only a 4% improvement in productivity performance over last-generation chips.

Another benefit of smaller die size is increased electrical efficiency, and that's helped in Broadwell by a new low-power audio subsystem. Intel claims its latest chips consume around half as much power as their Haswell equivalents when idle, and around 40% less power while playing video. This isn't quite as significant as it sounds, since the CPU accounts for only a fraction of a system's total power

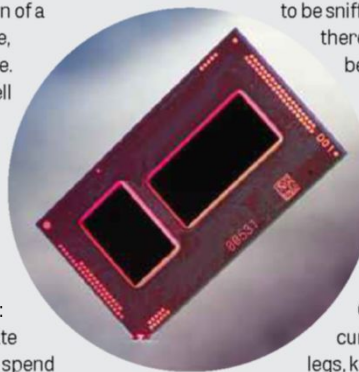
consumption. Once you factor the screen and the rest of the components into the calculation, the overall difference between Haswell and Broadwell laptops is less than 5% when idle, and a little more than 13% when watching a film.

One area where Broadwell does score significantly over Haswell is graphics. As with the previous "Tick" (2012's Ivy Bridge architecture), while shrinking the die Intel has also taken the opportunity to upgrade the GPU. In this case, a 22% increase in performance is promised – not something

to be sniffed at, especially if there's a chance you might be investing in a 4K display within the lifetime of your next PC.

All the same, we'd advise against buying a new laptop purely to get your hands on the latest CPU. Even if your current PC is on its last legs, keep an eye out for deals on Haswell systems, which may well be discounted as Broadwell filters into the mainstream.

And then there's the question of what's around the corner. Broadwell was originally intended to launch last year, but was held up by the technical challenges of the new 14nm manufacturing process. Now that the process is up and running, Intel plans to get back on track by switching production to Broadwell's successor – codenamed Skylake – in the second half of this year. Since Skylake is a brand-new architecture (a "Tock"), it's likely to bring significant new features and improvements, making it a more interesting upgrade than Broadwell.





Dell Venue 11 Pro 7000

Dell spruces up its superb 10.8in business tablet with Intel's Core M to create the best business tablet yet

SCORE ★★★★★

PRICE £454 (£545 inc VAT) from
dell.co.uk (pcpro.link/246dellven)

The Venue 11 Pro 7000 won't win any awards for groundbreaking design. Dell has barely deviated from the format of previous Venue 11 Pro models, save for moving a few ports around the tablet's edges, and it's fair to say the look remains more "functional business tool" than "funky Windows hybrid"; between this and the Microsoft Surface Pro 3, there's no contest in terms of looks.

It's well built, though. At 757g, it's light enough to wield in one hand, and the rubberised plastic rear stops it slipping. It feels like a quality device, and, if our Venue 11 Pro from last year is anything to go by, it should be more than capable of surviving day-to-day knocks and scrapes.

As ever, the Venue 11 Pro's high point is its Full HD display, which gives the Surface Pro 3 a run for its money. Maximum brightness is down on last year's model, but 398cd/m² is still bright enough for outdoor use, and a contrast ratio of 886:1 ensures images have plenty of pop. Colour is good, too: the Dell's IPS panel covers 91.7% of the sRGB colour gamut with a decent level of accuracy. The only sticking point is that greyscales are tinted with a slight greenish cast.

Behind the display, a dual-core Intel Core M processor now takes pride of place. Gone are the ultra-low-voltage Y-class Core i3 and Core i5 Haswell chips of previous models: instead you can choose from the 800MHz Core M-5Y10 and the 1.2GHz Core M-5Y71. Those speeds may sound fairly slow, but the Core M-5Y10 boosts up to 2GHz when required, with the Core M-5Y71 reaching 2.9GHz.

BATTERY: light use, 11hrs 21mins



REAL WORLD BENCHMARKS

3.4GHz Intel Core i7-2600K, 4GB DDR3 = 1

OVERALL 0.56



As a result, the Venue 11 Pro delivers nippy performance. Our review unit partnered the Core M-5Y10 with 4GB of RAM and a 128GB M.2 SanDisk SSD, achieving a respectable 0.56 in our Real World Benchmarks. That's a little behind the 0.59 scored by the HP Envy x2 13 (see p72), but the trade-off is a smaller, thinner chassis.

Battery life is good too, besting even last year's Atom-based model. With the screen set to 75cd/m² and Wi-Fi turned off, the Venue 11 Pro's 38Wh battery lasted 11hrs 21mins in our light-use browser test – almost an hour longer than its predecessor.

We remain impressed by the Venue 11 Pro's connectivity options, too. On the wireless front, it has dual-band 802.11ac, Bluetooth 4, Miracast and an optional 4G module. There's also video output via a micro-HDMI port, plus a single full-sized USB 3 port and micro-USB for charging.

A final nice touch – and one that IT departments in particular will appreciate – is that you can lever off the Venue 11 Pro's plastic rear to access and replace both the internal battery and the SSD. There's also an

ABOVE As with previous models, the Venue 11 Pro's highlight is its screen



+ Great performance, complemented by a top-quality screen and excellent flexibility
- Awkward to use comfortably in portrait mode

LEFT The Haswell chips of old have been replaced with Core M processors

optional tablet keyboard with a secondary 28Wh battery; in our tests, this almost doubled the Venue 11 Pro's battery life.

The Dell doesn't get everything right. The Surface Pro's 3:2-ratio screen feels more comfortable in both landscape and portrait orientations, and it offers a higher resolution, too. In addition, the Venue 11 Pro provides nowhere to stash the stylus and, while the tablet keyboard provides a comfy, usable keyboard and touchpad, it's annoying that you can't tilt back the display very far.

On the other hand, the Venue 11 Pro not only serves as a very likeable tablet, but it can also transform into a pleasingly compact ultraportable, and even a desktop PC replacement. Of course, the requisite accessories come as optional extras, so you'll have to shell out £29 for the active stylus, £160 for the tablet keyboard and £139 for the docking station.

Thankfully, the tablet itself isn't too pricey, especially if you can make do with a 64GB SSD. The entry-level model throws in a slim, clip-on keyboard for £559 inc VAT, while the model with the faster CPU and 128GB SSD comes in at £639 inc VAT – comparing very favourably with the Surface Pro 3. If you're after a nippy, long lasting and multitasking Windows tablet, the Venue 11 Pro hits the mark. **SASHA MULLER**

SPECIFICATIONS

Dual-core 800MHz Intel Core M-5Y10 • 4GB RAM • 128GB SSD • 10.8in 1,920 x 1,080 display • 2MP/8MP front/rear cameras • 802.11ac Wi-Fi • Bluetooth 4 • Windows 8.1 64-bit • 1yr C&R warranty • 279 x 177 x 11mm (WDH) • 757g



Chillblast Fusion Nano

High-end gaming power in a compact package – Chillblast takes full advantage of Nvidia's latest GTX 970 GPU

SCORE ★★★★★

PRICE £916 (£1,099 inc VAT) from chillblast.com (pcpro.link/246nano)

If you didn't think it was possible to squeeze serious gaming power into a compact case, take a look at Chillblast's Fusion Nano – a pint-sized performer that brings together Nvidia's new GTX 970 graphics, a water-cooled Intel Core i5 CPU and a premium mini-ITX motherboard.

It's tough to argue with Chillblast's choice of case: the Raijintek Metis is a handsome example of the breed. It comes in a choice of grey, red, green, blue, black and gold, and our blue sample looked very smart indeed.

The finish feels top-notch, too, with classy brushed metal all around, and a window on the right-hand panel. There's room inside for a full-sized ATX power supply and a 120mm fan at the rear – essential for powerful gaming components. To further improve airflow, Chillblast has also cut an extra vent into the roof of the case.

Our only minor moan is that the plastic around this top vent looks decidedly rough around the edges, but we understand why Chillblast has reached for the Dremel: the Fusion Nano's core components would normally reside in a far larger case. There's an Intel Core i5-4690K, pushed from 3.4GHz up to 4.4GHz thanks to the Corsair H55 watercooler; a dinky "mini-ITX" edition of Nvidia's GeForce GTX 970 occupying the single PCI Express slot; and a 250GB Samsung



840 Evo SSD, accompanied by a 1TB Seagate hybrid SSHD and 16GB of RAM.

With all this plumbed into the Asus Z97i-Plus motherboard, the Fusion Nano's performance is predictably solid. In our desktop benchmarks, the overclocked Core i5 and speedy SSD helped the Fusion Nano rack up an Overall score of 1.13 – a competent, if unexceptional result. This is around 10 to 12% slower than gaming PCs we've seen with Core i7 CPUs running at similar overclocks, but realistically there's more than enough va-va-voom here to handle high-end games for several years to come.

The unassuming miniature graphics card eschews the dual-slot coolers found on most high-end graphics cards, instead cramming a compact heatsink onto a card that measures a dainty 17cm long. But you still get plenty of connectors: there are three full-sized DisplayPort outputs, plus HDMI 1.4 and dual DVI.

And despite the card's modest size, Nvidia's Maxwell architecture – with

ABOVE Despite its compact size, the Chillblast Fusion Nano squeezes in a fine set of components

✚ Size, looks, great gaming performance
✚ Limited upgradability, and can be a little noisy

BELOW The extra vent at the top of the Raijintek Metis case helps to keep it cool

4GB of GDDR5 RAM – packs a mighty wallop. In our Crysis test, at 2,560 x 1,440 with Very High detail, the GTX 970 averaged 65fps. Even with the resolution cranked up to 3,840 x 2,160, the GTX 970 kept up a solid average of 31fps. When you consider that Chillblast's gaming beast from last year, the Fusion Dragon, managed only 37fps in the same test – with a Core i7 CPU and a stupendously expensive GTX 780Ti graphics

card – it's clear that the GTX 970 is a force to be reckoned with.

With all this power in such a small case, things do get hot. When we set FurMark and Prime95 to do their worst, the GPU happily ticked along at 60°C, but the CPU quickly hit 100°C. This shouldn't be a real-world problem, though: even under this unrealistic 100% load, the system remained smooth and stable.

Surprisingly, when it comes to power consumption the Fusion Nano is actually quite frugal. Even with both CPU and GPU working flat out, we recorded a maximum draw of 281W. Sitting idle on the Windows 8 desktop, this fell to 66W. It isn't too noisy either: even under heavy load, the GTX 970 and Corsair H55 unit emit only a low, unobtrusive whoosh of air.

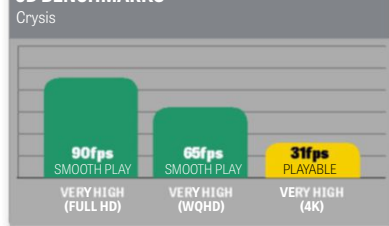
Finally, we also have to praise the sheer degree of connectivity packed into the Asus motherboard. There's 802.11ac Wi-Fi, four USB 2 ports and a total of six USB 3 ports – four at the rear and two at the front. Inside, a 10GB/sec M.2 socket sits ready for you to add a high-speed SSD, and if you need even more storage, there are also two spare SATA 6Gbits/sec ports.

We've seen a fair few compact gaming PCs over the years, but the Fusion Nano is one of the best. It's compact, good-looking and quiet, yet offers enough grunt to tackle the most demanding games head-on. If you're short on space and big on games, it's a great choice. **SASHA MULLER**

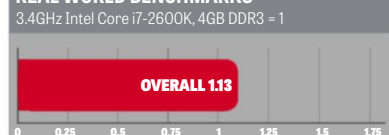
SPECIFICATIONS

3.4GHz Intel Core i5-4690K @ 4.4GHz • 16GB DDR3 RAM • 4GB Nvidia GeForce GTX 970 • 250GB Samsung SSD • 1TB SSHD • Gigabit Ethernet • Windows 8.1 64-bit • 2yr C&R warranty • 190 x 280 x 250mm (WDH)

3D BENCHMARKS



REAL WORLD BENCHMARKS



Asus ZenWatch

Asus brings a touch of luxury to Android Wear, with its sleek, good-looking ZenWatch

SCORE ★★★★★

PRICE £166 (£199 inc VAT) from
pcworld.co.uk (pcpro.link/246zenwatch)

Android Wear has yet to reach its first birthday, but we've already seen a healthy selection of hardware. The Asus ZenWatch is the latest, and it joins an increasingly capable crew.

Of all the Android Wear devices we've seen so far, the ZenWatch takes first prize for looks. Its slim, stainless-steel body – complete with “rose gold” inlay around the edges and a curved Gorilla Glass 3 touchscreen – lends it a touch of class; the tan leather strap and metal clasp, in combination with a selection of slick custom watch faces, top off the look nicely.

It's light and comfy – not something all the wearables we've tested recently can claim – and the hinged clasp is both secure and easy to release. If you don't like the brown strap, the ZenWatch's standard 22mm fittings mean you can easily swap it out with one of your choice.

■ Specifications and screen

Beneath that glitzy exterior, it's pretty standard fare. Similar to most other wearables we've encountered, the ZenWatch is both dust- and water-resistant: its IP55 rating means it isn't as tough as the Sony SmartWatch 3, but you'll be okay if you're caught out in a rain shower.

The screen is a square 1.63in affair, and boasts a resolution of 320 x 320 pixels for a pixel density of 278ppi. It uses AMOLED technology, and its vibrant colours and deep, dark black make it a joy to look at. It isn't as readable as the Sony SmartWatch 3 in direct sunlight – but indoors, and on grey days, it's far more appealing to the eye.

There are a couple of minor irritations, however. First,

because of the way the RGB subpixels are arranged, there's visible grain to the screen. Second, with the watch in ambient display mode, you'll often see that one edge of your watch face is chopped off – this is because the ZenWatch shifts the pixels around regularly to mitigate the effects of AMOLED screen burn.

Behind that screen sits a 1.2GHz Qualcomm Snapdragon 400 processor, 512MB of RAM and 4GB of storage. Although it isn't immediately obvious, the ZenWatch also includes a heart-rate monitor. This is integrated into the bezel of the ZenWatch: to read your pulse, you simply launch the Asus Wellness app and rest your index and middle finger lightly on each side of the watch face. It works quickly and is reasonably accurate – but only when used with the Wellness app; it's all over the place when used with Google Fit. There's also an

RIGHT The ZenWatch's stainless-steel clasp feels secure and is easy to release

“In addition to a selection of watch faces, you can use the ZenWatch Manager app to customise them and to set up proprietary features”

- ✦ Classy design, a comfortable leather strap and some genuinely useful customisations
- ✦ Short battery life and a clip-on charger; in ambient display mode, the screen moves around



option to measure your stress levels.

The only area in which the ZenWatch falls seriously short is stamina. Presumably because the watch is so

slim, Asus hasn't been able to squeeze in a large battery – and it shows. With the screen set to always on, we found it didn't last significantly longer than a day, and with heavy use it often didn't make it to bedtime, even after having been fully charged in the morning.

Our smartwatch battery benchmark proved the ZenWatch still can't compete with the best wearables on the market. With appointments set to trigger a notification every five minutes, and the screen set to always on, its projected runtime of one day





and ten hours is well short of the LG G Watch R's two days and 21 hours.

We also aren't particularly keen on the charger, a USB clip-on that wraps around the entire body of the watch. We'd prefer to see a micro-USB port such as that on the Sony SmartWatch 3, or wireless charging. Clip-on chargers are far too easy to lose.

Software

The ZenWatch comes loaded with the latest version of Android Wear, but it's great to see that Asus has made more of an effort to extend the ZenWatch's capabilities.

In addition to a selection of custom watch faces, you can use the ZenWatch Manager app (available to download and install from the Play store) to customise those watch faces, and set up proprietary features such as "Find my watch" and "Forgot phone warning".

You can also use the Manager app to activate extra tools on the

BELOW The USB clip-on charger wraps around the body of the watch



ABOVE Design-wise, the ZenWatch stands out for all the right reasons

watch, including a compass, flashlight, camera remote and SOS emergency dialler. The most useful of all the Asus extras, however, is the Wellness app, which keeps track of your steps and heart rate in a much more visually attractive manner than Google Fit.

Verdict

The Asus ZenWatch brings a touch of class to the world of Android Wear, and of all the smartwatches we've come across in the past year, it's the one we've been most taken with in terms of design.

Despite appearances, it isn't particularly pricey. At £199, it's slightly cheaper than the round-faced Motorola Moto 360 and LG G Watch R, and a little more than the Samsung Gear Live.

With better battery life, it would have been our new favourite Android Wear watch; as it is, however, unless you value appearance above all else, our top pick remains the LG G Watch. **JONATHAN BRAY**

SPECIFICATIONS

1.2GHz Qualcomm Snapdragon 400 CPU • 512MB RAM • 4GB storage • 1.63in square 320 x 320 AMOLED touchscreen • heart-rate monitor • Bluetooth 4 • 1.4Wh Li-poly battery • Android Wear • 1yr RTB warranty • 40 x 9.7 x 51mm (WDH) • 70g



How to subscribe



Print

Quote offer code P1504PF
Subscribe today with 3 issues for £1 then £24.99 every 6 issues plus free gift.



Print + Digital

Quote offer code P1504BF
Subscribe today with 3 issues for £1 then £28.99 every 6 issues plus free gift.

Plus get a FREE 8GB USB drive when you subscribe.



Order now:

dennismags.co.uk/pcpro

0844 844 0083

You can read PC Pro in print, on your iPad, iPhone or Kindle Fire, or via our Windows 8 app. **77**



Bush MyTablet 8

A Windows tablet that costs £80? The Bush MyTablet is small in stature but big on value

SCORE ★★★★★

PRICE £67 (£80 inc VAT) from
argos.co.uk (pcpro.link/246bush)

Back in 2013, Intel's Paul Otellini boldly promised that the Bay Trail Atom processor would power Windows devices priced "as low as \$200". It was an ambitious claim, but now the Bush MyTablet goes one better: this fully featured 8in Windows tablet costs just £80.

The headline specifications are impressive. You get an 8in, quad-core tablet running 32-bit Windows 8.1 with Bing, Microsoft's fully functional version of Windows designed for low-cost devices. You also receive a year's subscription to Office 365 Personal and 1TB of OneDrive cloud storage. On paper, it almost looks too good to be true.

In the hand, surprisingly, the MyTablet doesn't look or feel cheap. There's no give or flex in the 9mm-thick body, and the narrow bezels make for a smart, presentable-looking piece of hardware. The whole thing weighs a reasonable 366g.

The display, too, exceeded our expectations – by quite a stretch. While the 1,280 x 800 resolution won't win awards for pixel density, the IPS panel delivers wide viewing angles and a contrast ratio of 1,200:1 that makes for punchy and vibrant images. Maximum brightness isn't great at 260cd/m², but the panel was able to reproduce an impressive 78.3% of the sRGB colour gamut – better than the much pricier Apple iPad mini 3.

We noticed no issues with the touchscreen's responsiveness either, although one oddity is that the bezels creep slightly over the edges, which makes it difficult to tap onscreen buttons positioned right at the edge of

BATTERY: video playback, 7hrs 42mins



the display. Still, ridiculous as this sounds, it's a minor annoyance rather than a deal-breaker.

If you're wondering where the Start button is, you'll need to look closely: like several of its rivals, Bush has moved this control to the edge of the MyTablet, alongside the volume buttons. This takes a little getting used to, but it's a better position than squeezing a capacitive button into the tablet's slim bezels, where it would be easy to press by accident.

Inside the MyTablet, the Intel Atom Z3735G processor is supported by a mere 1GB RAM, which does lead to some stuttering if you try to multitask with demanding apps. Overall performance doesn't suffer, though: the Bush achieved a score of 0.38 in our Real World Benchmarks, placing it on par with its 2GB rivals.

The MyTablet's Atom processor also fares pretty well in mobile tests: it rattled through the SunSpider JavaScript benchmark in a nippy 504ms, and achieved single- and multi-core scores of 968 and 2,808 respectively in the browser-based Geekbench 3 test. That places it ahead

ABOVE Great build quality, decent connectivity options and a superb screen – the MyTablet delivers plenty for the money

"There's no give or flex in the 9mm-thick body, and the narrow bezels make for a smart, presentable-looking piece of hardware"

+ Compact, cheap, a decent display and Office bundled for free
- Terrible cameras, middling battery life and limited RAM

of luxury Android compacts such as the Samsung Galaxy Tab S 8.4 and the Sony Xperia Z3 Compact.

Connectivity is bang-on for the money. Wireless networking includes single-band 802.11n and Bluetooth 4, and the Bush even trumps some of its pricier big-brand rivals by providing a micro-HDMI socket and a microSD slot for expanding the onboard storage. The MyTablet charges via a micro-USB connection (a mains charger is supplied). This is On-The-Go-compatible, so you can use a third-party USB OTG cable or hub to connect external USB devices such as hard disks, keyboards and the like – although naturally you can't use them and charge the tablet at the same time.

The MyTablet also sports both 0.3-megapixel front and 2-megapixel rear cameras, although the image quality is dreadfully lacklustre. The rear-facing camera produces washed-out, low-resolution images smeared with compression artefacts; the front-facing camera is so blurry and lacking in detail that it's barely satisfactory for Skype calls. Frankly, you'd be better off drawing a self-portrait in Microsoft Paint. The Bush's speakers are similarly disappointing, with limited volume and little depth or clarity: if you want to enjoy movies, a decent pair of headphones is a necessity.

The Bush MyTablet's biggest bugbear, though, is battery life. With the display dimmed to 120cd/m² and Wi-Fi switched off, our 720p HD movie kept looping for a mere 7hrs 42mins – some way behind rival compact Windows tablets, and a long way off the stamina of the best Android and iOS devices.

Overall, the MyTablet remains a remarkable device for the price. If we were betting types, we'd have been

willing to wager that a £80 Windows 8 tablet would be a lost cause from the off. We'd have been wrong. The MyTablet's limited RAM and middling battery life may put off some people, but the only

real question mark concerns the imminent arrival of a flood of rival tablets at similar, ultra-low prices. It remains to be seen how these will measure up – but if you're after a lightweight Windows tablet right now, the Bush MyTablet represents incredible value. **SASHA MULLER**

SPECIFICATIONS

1.8GHz Intel Atom Z3735G • 1GB RAM • 32GB storage • 8in 1,280 x 800 IPS touchscreen • Intel HD Graphics • Windows 8.1 with Bing 32-bit • 1yr RTB warranty • 124 x 9 x 217mm (WDH) • 366g

Linx 10

A nippy, well-connected Windows tablet with a decent-quality screen – all at a very tempting price

SCORE ★★★★★

PRICE £133 (£159 inc VAT) from [amazon.co.uk \(pcpro.link/246linx\)](http://amazon.co.uk/pcpro.link/246linx)

With the mobile world still dominated by Android and iOS, Microsoft's new tactic is to push production of ultra-cheap Windows tablets. We've already been impressed by the Bush MyTablet 8in; now comes the Linx 10 – a 10in Windows tablet for only £159.

Just like the MyTablet, the Linx runs full Windows 8.1 32-bit "with Bing", and includes a one-year subscription to Office 365 Personal. Inside, there's a quad-core Intel Bay Trail Atom Z3735F CPU clocked at 1.33GHz (with burst speeds up to 1.83GHz), and 2GB of RAM – twice as much as the Bush.

This allows Windows 8.1's tile-based touch interface to whizz around without a hitch. Scrolling and panning in Internet Explorer is smooth; in the Geekbench 3 mobile benchmark, the Linx achieved competitive scores of 784 and 2,204 in the single- and multi-core tests, plus a respectable SunSpider time of 514ms.

Even demanding desktop apps are usable: we kicked off a 1080p video render using Sony Vegas Pro 10, and saw very little slowdown. It doesn't feel like a budget experience at all.

Of course, this is still an Atom processor, so those renders will take a while. In our desktop benchmarks, the Linx 10 returned an Overall score of 0.33 – a touch behind the Bush MyTablet, and miles off mainstream Core M and Core i3 devices.

Gaming isn't a strong point either: FIFA Ultimate Team and Despicable Me: Minion Rush were visibly jerky, and GFXBench wouldn't run at all during our testing – there

appeared to be some compatibility issues at play.

And although we were a little disappointed with battery life, it's far from disastrous. The claimed runtime is only six to eight hours, but dim the screen a touch and you should be able to eke out an hour more. With the screen set to a brightness of 120cd/m², the Linx 10 lasted 8hrs 59mins.

There's better news when it comes to screen quality. The 1,280 x 800-resolution, 10.1in display uses IPS technology, ensuring good brightness, contrast and viewing angles. According to our colorimeter, the Linx 10's display beamed out at 329cd/m² (much brighter than the Bush MyTablet), with a solid contrast ratio of 823:1. Photos and video look a little muted, but in general, this is a decent screen for the price.

It all comes housed in a chassis that, if not particularly classy, feels well made. Finished in matte, soft-touch black plastic, the design calls to mind the look of Amazon's HDX tablets, if not their slenderness. The slightly weak speakers are unhelpfully mounted on the rear, and the screen picks up grease and grime rather too easily for our liking, but you do get a decent array of ports and sockets: there's mini-HDMI, microSD

ABOVE For £159, you get the Linx 10 and a subscription to Office 365

✚ Cheap and responsive, with a generous one year of Office 365 Personal thrown in
✚ Poor cameras, and the screen is lacking in resolution

BELOW Design-wise, the Linx 10's matte, soft-touch finish is reminiscent of Amazon's HDX tablets



and a micro-USB socket with USB On-The-Go support for connecting external peripherals (an adapter cable is provided in the box). The tablet charges via a separate DC connector, so accessories can remain connected while charging.

On the wireless front, you get Bluetooth 4, but only single-band 802.11n Wi-Fi, and the tablet has 32GB of integrated storage – of which Windows and the Linx 10's recovery partition take up around half.

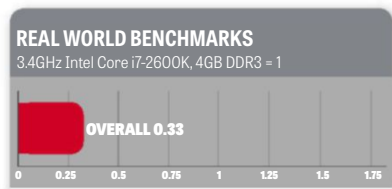
Perhaps the Linx 10's weakest point is its cameras. Although front- and rear-facing snappers are included, both capture at a low resolution of 2 megapixels, and the resulting images look smeary and unpleasant.

At £159, the Linx 10 is considerably more expensive than the Bush MyTablet, and next to other popular budget tablets – such as the Android-based, 8.4in Tesco Hudl 2 – its lower-resolution display counts against it.

However, once you weigh in the Office 365 subscription (worth £48 alone), and the fact that, with a monitor, keyboard and mouse, the Linx could plausibly replace your main home computer, that price looks more palatable. If you're in the market for an entertainment device and basic home PC in one low-cost package, the Linx 10 is definitely one for your shortlist. **JONATHAN BRAY**

SPECIFICATIONS

1.33GHz Intel Atom Z3735F • 2GB RAM • 32GB storage • 10.1in 1,280 x 800 IPS touchscreen • Intel HD Graphics • 7,900mAh battery • Windows 8.1 with Bing 32-bit • 1yr RTB warranty • 258 x 11.5 x 172mm (WDH) • 588g





0101011100111
1101010010
10101011010100

"Danger", 13, 10, '\$'

0100101010100101010
1110010010
001000101010
00010111010

0101

000101010101010
01010101
01110101110
10010
1001011010110

IDEAL
MODEL SMALL
STACK 100H
DATA SEG
HW DB
CODE SEG

Begin
MOV AX, @data
MOV DS, AX
MOV DX, OFFSET HW
MOV AH, 09H
MOV AX, 4C00H
MOV DX, OFFSET HW
INT 21H
MOV AX, 0
INT 21H

IDEAL
MODEL SMALL
STACK 100H
DATA SEG
CODE SEG

Begin
MOV AX, @data
MOV DS, AX
MOV DX, OFFSET HW
MOV AH, 09H
MOV AX, 4C00H
MOV DX, OFFSET HW
INT 21H
MOV AX, 0
INT 21H

IDEAL
MODEL SMALL
STACK 100H
DATA SEG
CODE SEG

Begin
MOV AX, @data
MOV DS, AX
MOV DX, OFFSET HW
MOV AH, 09H
MOV AX, 4C00H
MOV DX, OFFSET HW
INT 21H
MOV AX, 0
INT 21H

NTI

WHICH PACKAGE CAN YOU TRUST

7 7 17 11 90 5A
8 8 18 12 100 64
9 9 19 13 500 1F4
10 A 20 14 1000 3E8

host1(int sys, int parm)

\$0x80\n"

(sys)

(sys), "b" (parm));

110101010
1011100101010101
0101

110

1010101010110

1010101

1010010

10010101010101010

111010

10101101010100010110

model small
stack
data
message db "Connecting...", "\$"

"Connecting...", "\$"


```

IDEAL
MODEL SMALL
STACK 100h
DATASEG
    HW DB "Danger", 13, 10, '$'
CODESEG

```

Begin:

```

MOV AX, @data
MOV DS, AX
MOV DX, OFFSET HW
MOV AH, 09H

```

INT 21H

MOV AX, 4C00H

INT 21H

END Begin

MOV AX, 56h

XOR SI, DI

```

IDEAL
MODEL SMALL
STACK 100h
DATASEG
    HW DB "Denver", 13, 10, '$'
CODESEG

```

Begin:

MOV AX, @data

MOV DS, AX

MOV DX, OFFSET HW

MOV AH, 09H

INT 21H

MOV AX, 4C00H

INT 21H

END Begin

VIRU

TO PROTECT YOUR DEVICES?

Contents

Kaspersky Internet Security 2015	88
Avast Free Antivirus 360 Safe	89
Internet Security AVG AntiVirus Free 2015	90
Bitdefender Internet Security 2015	91
Eset Smart Security 8	91
McAfee Internet Security	92
Microsoft Security Essentials	92
Norton Security 2015	93
Trend Micro Maximum Security	93
How we test	82
Home security	84
Feature table	86
View from the Labs	94
Test results	94

The internet-security landscape is changing fast, mirroring the changes in how we use technology.

Threats are no longer only in the form of viruses, trojans, worms and spyware – although these remain as common as ever – and they no longer attack only your PC.

Mobile devices are increasingly being targeted, with Android the fastest-growing platform for malware around the world. Cybercriminals are as interested in the feed from your webcam as they are in the data stored on your hard disk. Hackers and malware coders are continually working to find new ways to exploit vulnerabilities in web platforms and social networks, while high-profile security breaches have shown that the convenience of cloud computing comes with a dark side, too.

Luckily, the leading internet-security specialists are working just as hard to develop more effective ways of detecting and neutralising emerging threats. They're adding features to make internet shopping and banking safer, and are doing the same for social networking.

They're building and improving tools that analyse or identify malignant websites, and delivering more effective protection against phishing and ID theft. Meanwhile, security packages are now bundling protection for mobile ➔

devices. Keeping up with the threats is a challenge, but the best anti-malware packages are doing a credible job.

What to look for

Antivirus and anti-spyware protection is still the core of any good security package, and the best applications now take a heuristic approach – not just checking files against the signatures in their database, but also continually monitoring your computer for signs of malware-like behaviour. Malware might be deflected before it can infect your PC, or simply neutralised once it's installed; most apps have a quarantine area in which suspicious files can be isolated for deletion or, in the case that they've been blocked unjustly, restored.

Yet anti-malware tools aren't the be-all and end-all. The better packages replace Windows' rather basic built-in firewall with more sophisticated features. Web protection is rapidly becoming de rigueur too, as the security companies understand that preventing infection and educating users can be more effective than dealing with the infection once it's taken hold. However, there's always a balance to be met between providing strong security and spoiling your surfing experience by switching search engines or adding in a slow, intrusive toolbar. Some packages manage this better than others.

Beyond this, you'll find packages with hardened browsers for secure online shopping and banking; tools to scan for malware in Facebook

posts or other social network feeds; secure file-shredders to ensure that deleted files remain deleted; and encryption tools to secure your data. A number of packages now include password-management features, too, where an application manages your login details across different online services and sites, giving you only one strong password to remember.

Meanwhile, parental controls allow you to define how and when specific user accounts on your PC can access the internet, restricting access to adult content or even age-rated games and applications.

Developers also like to throw in bonus features, often focused on optimisation, backup or synchronisation. Many of these can be found as standalone utilities, often for free, but it's useful to get them as part of the bundle. Some packages do a better job of integrating them with the core security tools than you might expect.

Do not disturb

A security package that can't offer you a decent level of security isn't worth having but, on the other hand, one that continually prompts you with queries and notifications or consumes valuable system resources will only get in the way.

The good news is that we're now finding most packages are lighter on their feet than they used to be, working well on older systems or Atom-based Windows tablets.

There are exceptions, however, and they're worth avoiding.

There's also a lot of variation in terms of how quietly security software runs. A few in this test still bother the user with regular queries, interrupt work or entertainment tasks, or prevent legitimate applications from installing.

The best packages out there know when to stay out

"The best applications take a heuristic approach, continually monitoring your computer for signs of malware-like behaviour"

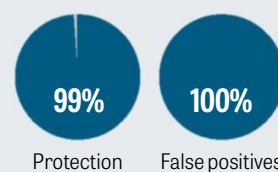
BELOW Developers are constantly building new features into their suites

How we test

Each package's core anti-malware features are tested at the state-of-the-art facilities of Dennis Technology Labs. Rather than artificially infecting our target systems, we set them up in an environment that mimics how our PCs become infected in the wild, to get an accurate picture of how each security package fends off malware in real-world situations.

We look at whether the package provides protection, and also how it handles each threat. The resulting data informs a protection rating of up to 100%. Meanwhile, we also install legitimate software to see what the security packages block and where they prompt for user intervention, factoring in the obscurity or otherwise of the application. We award a score for false positives (100% represents a perfect record) and combine this with the protection rating to provide an overall score (see test results, p94).

After formal testing, we run through each package to check its other features and get a feel for its usability, its burden on system resources and the user's ability to configure how it works. All this information is factored into its final, Overall rating.

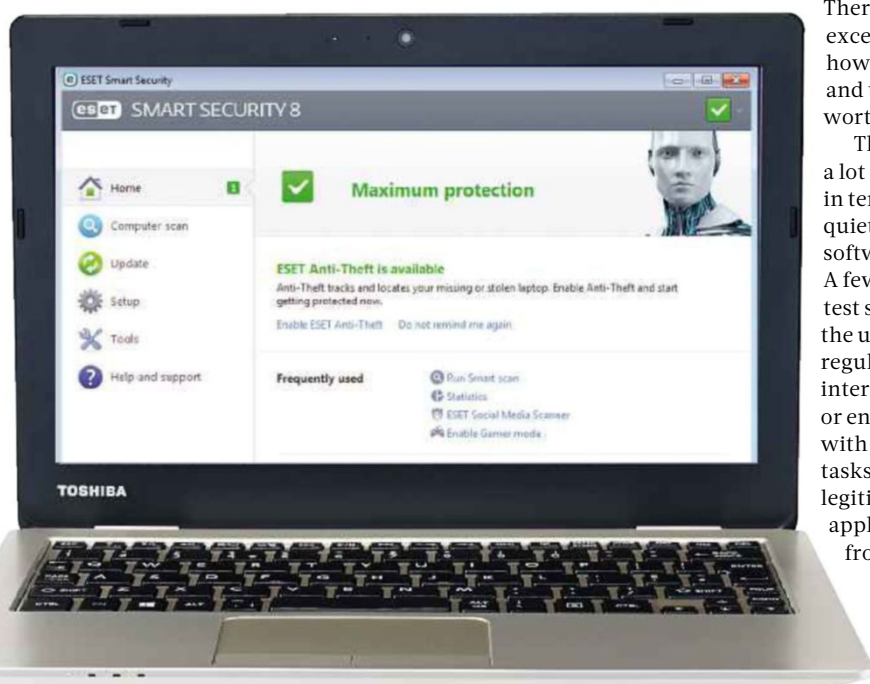


of sight, and even have "gamer" or "movie" modes that are purposefully designed to ensure you're not disturbed at the wrong moment.

Multiple devices

The days of one PC per household are long gone, and many of us now have two or more desktops or laptops in the house, plus smartphones and tablets to consider. While you can still buy packages or licences covering one machine for one year, many support three or more PCs and mobile devices, providing one-stop protection.

This type of protection is worth having if you have several PCs to secure, and it's worth noting that the threat via mobile devices is growing. For our security expert's take on this, see Davey Winder's Real World Computing column this month (see p118).





Minerva

"Under a grand nets you a system that is powerful enough to use in any gaming title you care to play..."

Bryan Water, OC3D.net

- Overclocked Intel® Core™ i5-4690K Quad Core
- **Windows 8.1**
- 16GB HyperX DDR3 FURY 1600MHz
- 120GB HyperX 3K SSD
- 2TB 7,200RPM HDD
- 4GB NVIDIA® GeForce® GTX 970
- 3 Year Standard Warranty

from
£999*



Vortex 440

"a true winner of a system; offering great value for money, epic all-round performance and superior build quality."

Ryan Martin, eTeknix.com

- Intel® Core™ Six Core i7-5820K CPU
- **Windows 8.1**
- 16GB HyperX DDR4 Predator 2400MHz
- 240GB HyperX 3K SSD
- 2TB 7,200RPM HDD
- 4GB NVIDIA® GeForce® GTX 970
- 3 Year Standard Warranty

from
£1599*



Predator X99

"The Predator X99 is built to very high standards and designed for a myriad of duties including 4K."

Zardon, KitGuru.net

- Intel® Core™ Six Core i7-5820K CPU
- **Windows 8.1**
- 16GB HyperX DDR4 PREDATOR 2400MHz
- 240GB HyperX 3K SSD
- 2TB Seagate SSHD
- 8GB AMD Radeon™ R9 295X2
- 3 Year Standard Warranty

from
£2299*



Ultranote II

"what you do get with the UltraNote II is more than just alright. It gets the job done, and does so at a reasonable price."

TechRadar.com

- 15.6" Full HD IPS Display (1920 x 1080)
- Intel® Core™ Quad Core i3-4110M CPU
- **Windows 8.1**
- 8GB Kingston 1600MHz
- 500GB 5,400 HDD
- Intel® HD Graphics 4600
- 3 Year Standard Warranty

from
£514*



Optimus V X13

"Need a powerful 13 inch laptop? The Optimus V X13 packs a serious punch!"

Zardon, KitGuru.net

- 13.3" Full HD IPS Display (1920 x 1080)
- Intel® Core™ Quad Core i7-4710MQ CPU
- **Windows 8.1**
- 8GB HyperX DDR3 IMPACT 1600MHz
- 1TB Seagate SSHD
- 2GB NVIDIA GeForce GTX 860M
- 3 Year Standard Warranty

from
£749*



Defiance 980

Get all the power you need to run the latest games with ease, in this slim gaming laptop! Featuring the new 9-Series graphics, you'll never be running low FPS.

- 15.6" Full HD Display (1920 x 1080)
- Intel® Core™ Quad Core i7-4710HQ CPU
- **Windows 8.1**
- 16GB HyperX DDR3 IMPACT 1600MHz
- 120GB HyperX V300 SSD
- 4GB NVIDIA GeForce GTX 980M
- 3 Year Standard Warranty

from
£1409*

SAVE £15
on your order
code: **PRO15**

www.pcspecialist.co.uk
0333 011 7000



Home security

It isn't only your laptop and PC you need to protect these days, but other devices too

The way we use the internet, and the devices on which we use it, are changing, both in business and within the home. Where once internet security meant defending Windows from malware, one PC at a time, now it involves securing a network, and protecting multiple devices and operating systems from a whole range of online threats. While installing good security software on every PC in your home should be a priority, it isn't the only security measure you should take.

■ Secure your PCs and laptops

Desktop and laptop PCs are still the most vulnerable devices in your home, partly because Windows has been the primary target for hackers for several decades, and also because they either hold or provide access to so much sensitive data.

First things first, ensure they're all running recent, fully updated security software. Next, check that your operating system is up to date. Whether you're using OS X, Windows 8, 7 or Vista, ensure the latest patches and updates have been applied; if you're using Windows XP, consider switching to something that's still supported by Microsoft, or a reliable Linux distribution instead.

Windows Update may be a pain, but it's still the best way to ensure that Windows stays patched and secure.

While you're at it, keep your applications up to date too, particularly your browser.

Finally, avoid logging on with the main administrator account. Sure, using an account without admin rights can be annoying if you want to install software, but it's much safer for the same reasons. We all know we should do it, even if we don't.

■ Secure your router

Running a wireless network without security is folly, putting you at risk of attacks from remote locations, and infiltration and/or piggybacking from nearby. Switching to a WPA2-protected network is a smart idea – thankfully the days of some devices only supporting the insecure WEP protocol seem to have gone – and choosing a strong password will help keep your network stranger-free; avoid anything obvious, such as your surname, pet's name or house name.

For additional security, turn off SSID broadcasting, so those making a new connection can do so only if they know the network name. It also won't turn up when neighbours scan



ABOVE If any of your online providers offer two-step authentication, use it

BELOW Your wireless router is a single point of vulnerability, so make sure it's fully locked down

for available networks. Again, changing the SSID to something you can remember, but isn't obvious to others, is a good idea. Similarly, if you absolutely must run a guest network, make sure it's secured via WPA2 – and don't allow guests to have access to network resources.

Finally, protect your router's configuration. Most offer password protection for the settings: you should change yours from the easily researched manufacturer's default. Keep your firmware updated and disable administrator access through the web. It's also a good idea to disable WPS and UPnP (if you don't need it).



■ Secure your mobile devices

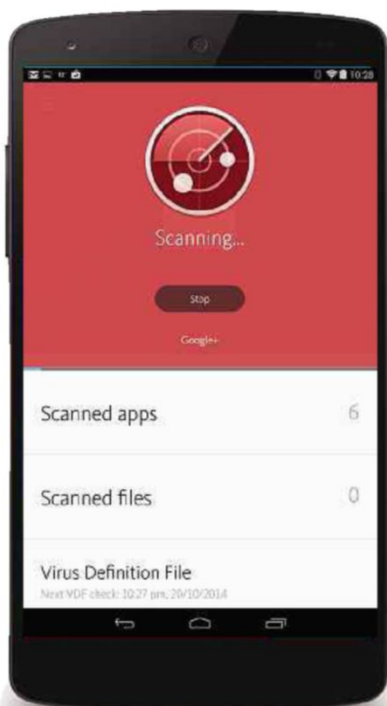
The most important consideration with mobile devices is physical security. Keep an eye on them when you're out and about, and have the lockscreen passcode-protected or locked with biometric security; this will prevent a lost or stolen tablet or smartphone from opening up the gates to internet services and accounts at online stores.

What's more, both Android and iOS have features to enable you to lock down and even wipe a stolen device remotely. With iOS devices, you can use iCloud's Find My iPhone/iPad feature, while Android has this function built into Android Device Manager.

Apple and Windows Phone devices don't require additional security software; Apple keeps a tight grip on iOS security, while hackers and malware coders aren't really bothered enough to attack Windows Phone.

Android is another story, however. In theory, Google's security efforts should keep the OS clear and apps free of infection, yet it's the fastest-growing platform for malware, with many infections originating in side-loaded apps from unofficial stores. Some of the malware is particularly nasty, sending SMS messages to premium numbers or replicating itself over Bluetooth, and it's difficult to spot and even harder to remove.

Unofficial app stores should of course be avoided, but it's still worth installing free security apps from Google Play – and some PC security suites now provide complimentary mobile software as part of the bundle. Avira Antivirus Security is one such example, while Eset Mobile Security



& Antivirus is free for basic use and affordable even with the £5 premium subscription.

■ Online services

Security doesn't stop with physical products; think carefully about the online services you use, too. Start by not being lax when it comes to passwords: make them lengthy and awkward to guess or break systematically, and if you can't manage that or have trouble remembering them, then consider using a password-management tool to recall the details for you.

Never use the same password across all your accounts; if one online game or service has poor security on its servers, cybercriminals could end up with access to sensitive data and even credit card details.

If a service offers two-factor authentication – and many now do – then use it. You'll receive an SMS message every time somebody wants to access the service from a new device, and without access

ABOVE Consider using a NAS appliance for local backups of larger files such as home videos



to your phone, hackers won't be able to break in.

Finally, try to avoid providing information on social networks that might be used to guess usernames or passwords, or information that could be used to reset them. It's been suggested that the celebrities targeted in last year's iCloud breaches were hacked because too much information was available online, allowing hackers in through the backdoor. We doubt many PC Pro readers have naked selfies stored in the cloud, but isn't it better to be safe than sorry?

■ Disaster recovery

No business should be without a disaster-recovery plan, providing cover in the event of a catastrophic

hardware breakdown, fire or theft. The same should be true of every home. Cloud-based storage and backup services are ideal for archiving and protecting your most

important and least replaceable files – whether documents, digital photos or home movies. External hard disks can handle the bigger, lower-priority stuff, or consider using a NAS to cover both your PCs and mobile devices in the home.

■ Old hardware

Finally, recycling or donating old hardware when you're no longer using it is a good thing. Doing so before it's properly wiped, however, is not. You can find details of how to do this at pcpro.link/246erashdd.



	360 Safe Internet Security	Avast Free Antivirus	AVG AntiVirus Free 2015	Bitdefender Internet Security 2015	Eset Smart Security 8	LABS WINNER Kaspersky Internet Security 2015	McAfee Internet Security	Microsoft Security Essentials	Norton Security 2015	Trend Micro Maximum Security
Overall	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
Pricing										
Publisher	360safe.com	avast.com	free.avg.com	bitdefender.co.uk	eset.co.uk	kaspersky.co.uk	mcafee.com	microsoft.com	norton.com	trendmicro.co.uk
Supplier	360safe.com	avast.com	free.avg.com	amazon.co.uk	shop.eset.co.uk	ebuyer.com	pcworld.co.uk	microsoft.com	amazon.co.uk	trendmicro.co.uk
Price (inc VAT) ¹	Free	Free	Free	£13 (£16)	£32 (£40)	£17 (£20)	£14 (£18)	Free	£29 (£37)	£33 (£42)
Subscription terms	N/A	N/A	N/A	1yr; 3 PCs	1yr; 1 PC	1yr; 3 devices	1yr; 3 PCs, 3 devices	N/A	1yr; 5 devices	1yr; 3 devices
Features										
Antivirus	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Firewall	✗	Only via premium version	Only via premium version	✓	✓	✓	✓	✗	✓	✓
Link protection	✓	✗	✓	✓	✓	✓	✓	✗	✓	✓
Parental controls	✗	✗	✗	✓	✓	✓	✓	✗	✓	✓
Encryption	✗	✗	Only via premium version	✗	✗	✗	✗	✗	✗	✓
Data shredder	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗
Secure browser	Only via premium version	Only via premium version	✓	✓	✗	✓	✗	✗	✓	✓
Anti-spam	✗	Only via premium version	Only via premium version	✓	✓	✓	✗	✗	✓	✓
Network scanner	✗	✓	✗	✗	✗	✗	✓	✗	✗	✗
Gaming mode	✗	✓	✗	✓	✓	✓	✗	✗	✓	✓
Vulnerability scanner	✗	✓	✗	✓	✗	✓	✓	✗	✓	✓
Rescue media creation	✗	✓	✗	✓	✗	✓	✗	✗	✓	✓
Browser cleanup	✗	✓	✗	✓	✗	✓	✓	✗	✓	✓
PC optimisation	✗	✗	✗	✓	✗	✓	✗	✗	✓	✓
Remote assistance	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗
Mobile app	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓



PROLITE B2888UHSU

THINK BIG



28"

1ms





Kaspersky Internet Security 2015

Unobtrusive, and packed with useful features – Kaspersky's security package remains the best-in-breed

SCORE ★★★★★

PRICE 3 devices/1yr, £17 (£20 inc VAT)
from pcpro.link/246kaspersky

Having held on to a place on our A-List with its 2014 edition, Kaspersky Internet Security isn't about to relinquish it. Like previous versions, the 2015 edition hits a sweet spot between the features and in-depth configuration options of Eset and Norton, and the set-and-forget usability of Microsoft Security Essentials and Avast.

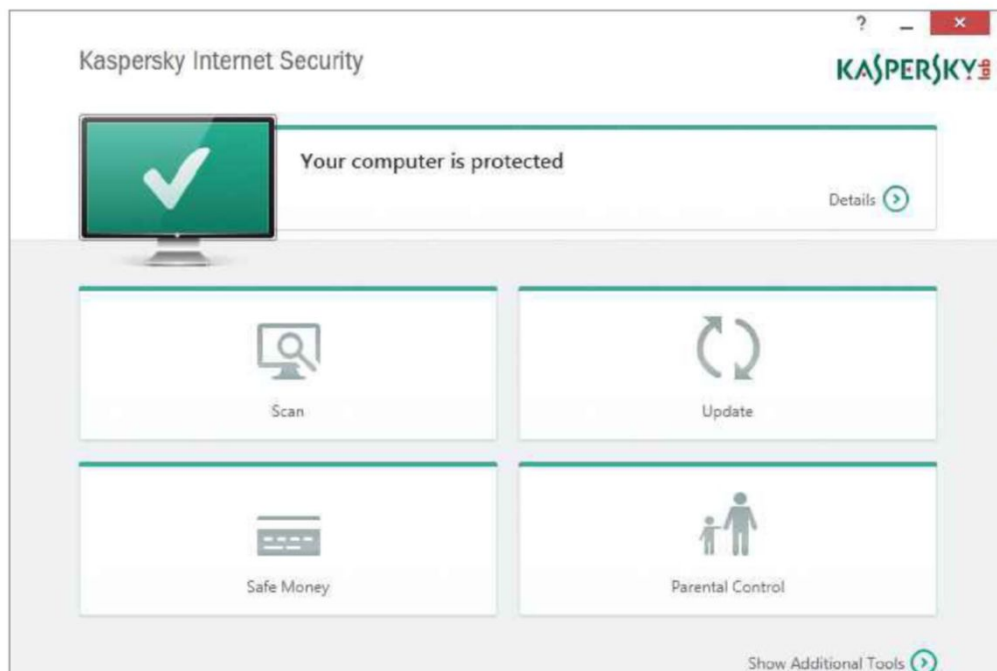
The default configuration neither requests nor needs much user input, and it's both unobtrusive and smart when handling legitimate software; it was the only paid-for package on test that permitted every legitimate application to install without user intervention.

All the same, it has plenty of features. The Safe Money browser is particularly useful, providing extra security in a hardened version of your current browser, protecting against such exploits as remote screen-grabbing. You can inform Kaspersky of which websites to launch within the browser manually, and it can prompt you when you visit your bank's login screen or an online store's checkout page. The onscreen keyboard is first-rate, foiling keyloggers at a click when you need to enter your credentials.

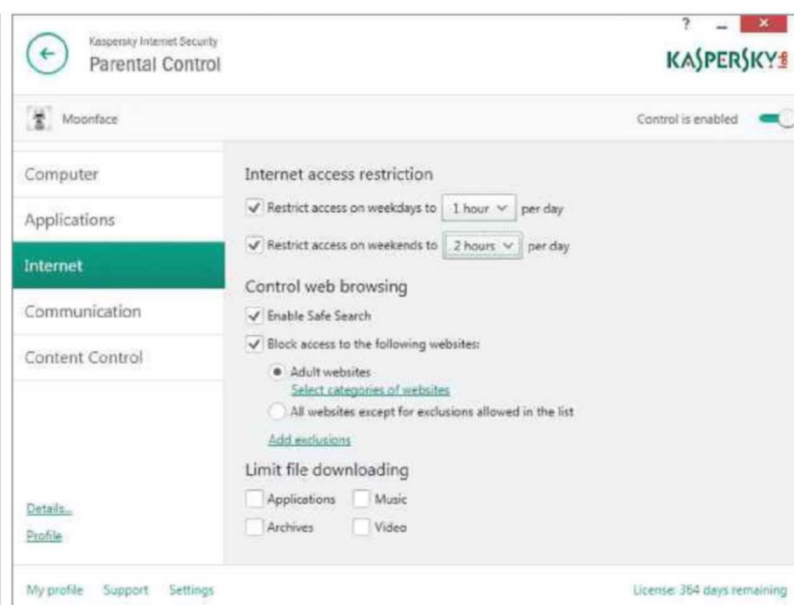
Kaspersky also offers a vulnerability scanner; a browser checker to search out potential weaknesses; a privacy cleaner to remove sensitive information; and a rescue disc utility. What's more, it has a fully comprehensive set of parental controls, with features to block or allow PC use and/or internet access at specific times during weekdays or weekends, and an option to set up breaks, say, for half an hour after every hour.

Games can be blocked – by age rating or filename – alongside access to adult web content. You can whitelist or blacklist contacts for communications, or even outlaw the use of certain keywords on web forms.

Despite all these goodies, Kaspersky handles the basics well.



RIGHT Kaspersky's parental controls are the most impressive we've seen in a security package



Although this release still makes it slightly awkward to reach some features, the UI is becoming more focused on providing access to the most important security tools. The settings reach good levels of detail, and you can switch components on or off, choose how the system reacts to detected threats, and use a Gaming Profile to avoid being interrupted when playing games

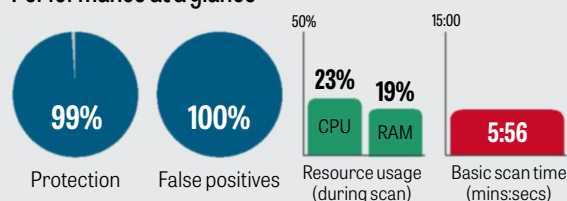
or watching videos. There's a lot to get to grips with, but it's presented in a straightforward manner that's easy to understand.

Crucially, Kaspersky retains the crown when it comes to strong security. It protected against 99% of threats in our tests – only Eset was better, with a 100% score.

While scanning, CPU usage stayed below 25% on our dual-core system, and memory usage was kept below 20%. Kaspersky is clearly confident about its footprint: it has a built-in system resource monitor to show what it's using.

It isn't the only security package in town – Norton, Eset and Avast are also excellent choices – but Kaspersky remains, on balance, the best of the bunch. When you can pick up a one-year, three-device licence for £20, it's practically a steal.

Performance at a glance



Avast Free Antivirus

A solid proposition that's easy to use and has a well-balanced set of features – plus it's free

SCORE ★★★★★

PRICE Free from pcpro.link/246avast

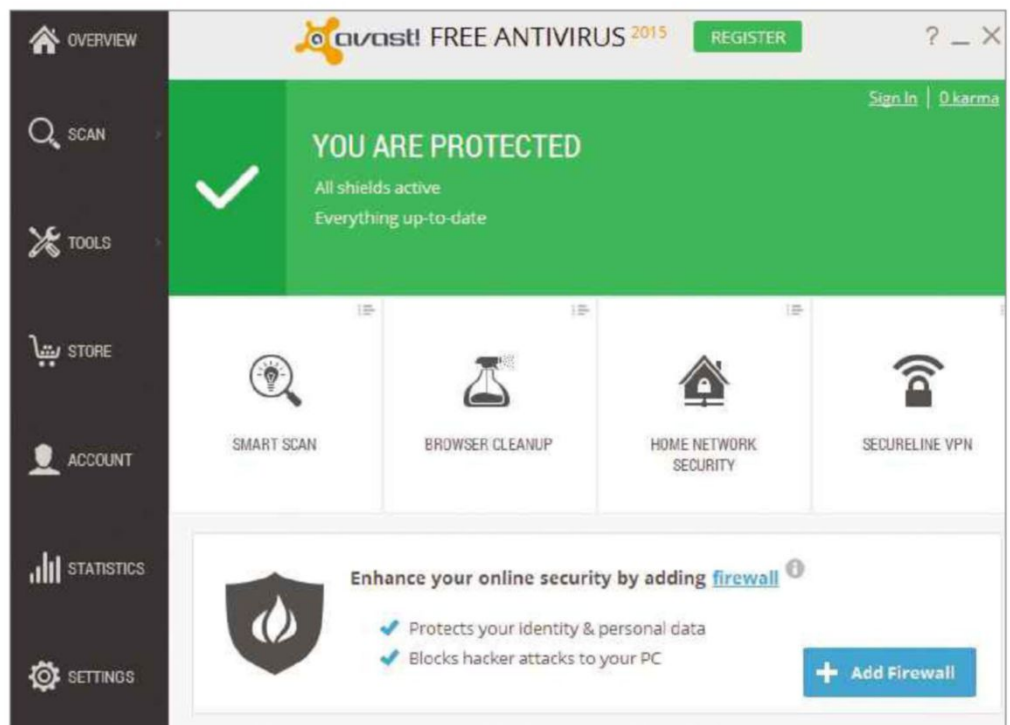
Avast Free Antivirus was our pick of the free packages last year, and this year we see little reason to change our minds. With a wealth of useful features – including strong anti-malware protection – it keeps your PC secure, while its relaxed approach to flogging premium features and skill at identifying legitimate software make it a pleasure to live with. If you don't want to pay for security software, it's the most balanced proposition.

It gets off to a good start. The package downloads the latest signatures during the initial install, then performs a quick scan as soon as setup is complete. The UI is equally straightforward, exposing all the major features in a clean, pane-based interface.

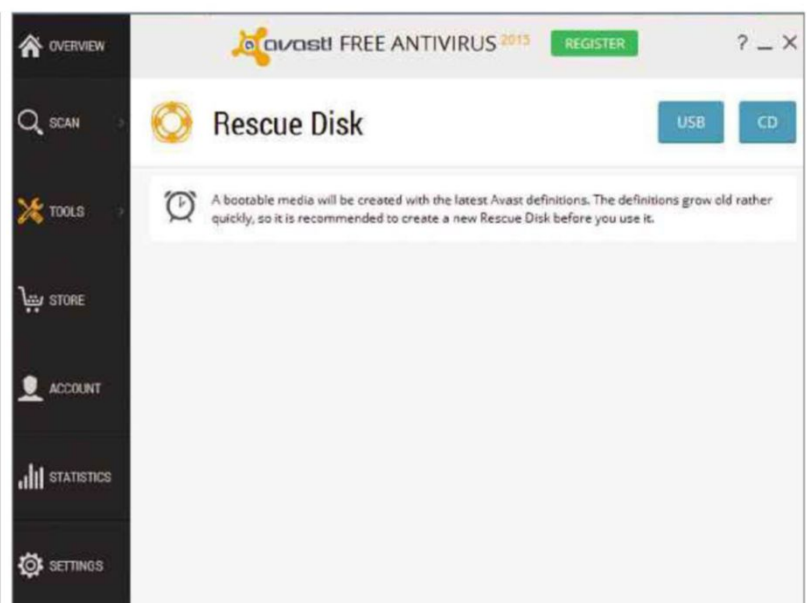
The main Overview panel reveals what's protected at a glance, while exposing the core Scan, Browser Cleanup and Home Network Security tools, plus the SecureLine VPN service. The latter is – like the firewall, anti-spam and secure online-banking features – a paid-for extra, but the software is upfront about this and doesn't endlessly nag about upgrading. Avast's built-in store may be only one click away, but no-one is forcing you to use it.

For a free package, Avast packs in plenty of additional features, with a rescue disk tool for creating bootable USB sticks or CDs with antivirus software and the latest definitions preinstalled, plus a browser cleanup feature that gets rid of irritating toolbars and extensions. The Home Network Security feature checks out your entire home network for potential risks, while the software updater can reveal whether the likes of Java and Adobe Flash are up to date. Both features speak of a more holistic approach to security than that taken by the other free packages.

When it comes to scanning, you can choose between a quick scan, a full system scan, and options to scan specific folders or removable media, plus a boot-time scan to deal with nasties that can't be handled following startup. You can also



RIGHT Avast's free software includes a rescue disk tool for creating bootable USB sticks

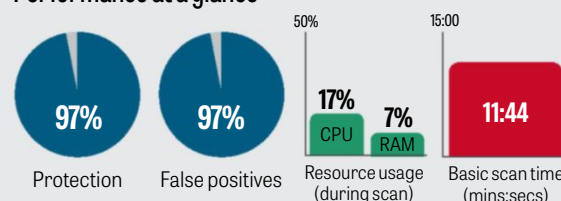


control how the package behaves, putting it in Silent mode with no pop-ups or alerts for gaming, or a Hardened mode to protect inexperienced users. Avast even includes a series of statistics screens, where you can see not only the good work it's doing on your behalf, but also how its anti-malware crusade is working around the globe.

The package comes close to matching the performance of the best paid-for software when it comes to protection, defending against 97% of threats, and in most cases preventing them from getting a foothold on the system, rather than neutralising them after the fact. 360 Safe performs better, with 99% protection, but falls behind Avast when it comes to false positives, since it blocks more legitimate applications. The weaker protection is notable, but not so significant that we'd prefer 360 Safe's anti-application paranoia over Avast's common sense approach.

Avast is also fairly light on system resources, not noticeably slowing down our ageing dual-core PC. With all these strengths, it deserves to walk away with an award.

Performance at a glance





360 Safe Internet Security

The best protection of any free package, using multiple antivirus engines to mop up malware

SCORE ★★★★★

PRICE Free from pcpro.link/246safe

The 360 Safe Internet Security suite nearly has it all, with great protection, useful features and a simple, intuitive UI. Unfortunately, it has an Achilles heel that prevents it from snapping up an award.

What's most interesting about this software is that it uses a combination of antivirus engines, with 360's own cloud engine backed up by QVM II and Bitdefender technologies. Those who upgrade to the Total Security package receive Avira's engine too.

The free version's features are focused on security, with a sandbox where you can drag programs to run

in isolation of the OS, and a cleaner that wipes all traces of activity from your browser history, Windows history and Microsoft Office. You'll also find internet protection, with URL and download filtering, plus anti-keylogging and webcam-hijack protection, plus tools for scanning USB devices.

It's hard to fault 360 Safe on the protection front: it caught 99% of threats aimed at our target systems. It tends to neutralise more threats than Norton or Kaspersky, meaning they're evicted once they've made themselves at home, but your PC remains protected either way.

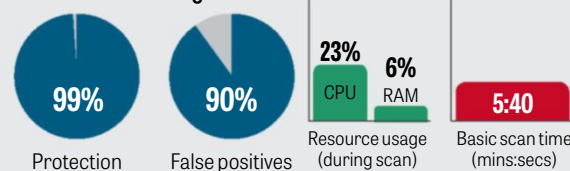


ABOVE 360 Safe can be a little too obtrusive

Unfortunately, 360 Safe can be overzealous, resulting in a greater number of false positives than any other package on test. It blocked two legitimate applications outright and recommended blocking a further seven, requiring user intervention to allow the applications to install. We also found it harder on system resources than Avast.

Overall, 360 Safe can be a little too onerous to use and obtrusive, but if its developer Qihoo 360 can sort that out, this will definitely be one to watch.

Performance at a glance



AVG AntiVirus Free 2015

Intrusive upselling and lacklustre protection make this free software option one to avoid

SCORE ★★★★★

PRICE Free from pcpro.link/246avg

AVG's free antivirus package seems to have lost its way in the past few years, focusing too heavily on upselling to its paid-for products, and too little on ensuring it's the best of the free tools. Sadly, this continues in the 2015 release.

Even during installation the software tries a pre-emptive bait-and-switch, asking you to choose between installing a free trial of AVG Internet Security, or the free product you previously selected. Guess which is the default? Meanwhile, every page of the UI features an advert suggesting that you "maximise your protection" by upgrading to the paid-for suite.

The line-up of features is basic. Firewall and anti-spam are paid-for

extras, while the web-protection features add AVG Secure Search and an extension – AVG Web TuneUp – to your browser. The former rather annoyingly switches the homepage and default search to the AVG Secure Search homepage (powered by Yahoo) without asking. On the plus side, AVG is a highly configurable package, with options to schedule scans, scan for rootkits and disable notifications and sounds, while the Windows 8-inspired interface looks clean and makes it easy to find your way around.

AVG's biggest problem isn't overbearing marketing or a lack of features, however, but the fact that its anti-malware protection lags behind most of its rivals. It came second from

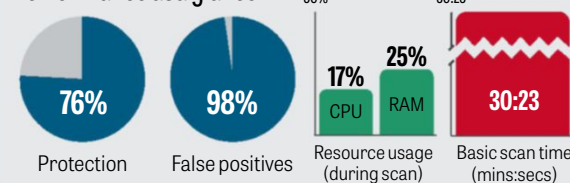


ABOVE AVG's package allows you to schedule scans and disable notifications

bottom in our tests for protection, defending against only 76% of threats. While this puts it ahead of Microsoft Security Essentials, it incorrectly blocked more legitimate applications along the way.

AVG also places a greater burden on resources, noticeably slowing down performance in browser-based tasks. Overall, it isn't a disastrous effort, but where AVG once matched the paid-for packages on malware protection, it's now falling short of the mark. Avast's free option is the better of the two by some distance.

Performance at a glance



Bitdefender Internet Security 2015

Packed full of innovative features, but protection doesn't match that of the best in this group

SCORE ★★★★★

PRICE 3 PCs/1yr, £13 (£16 inc VAT) from pcpro.link/246bitdef

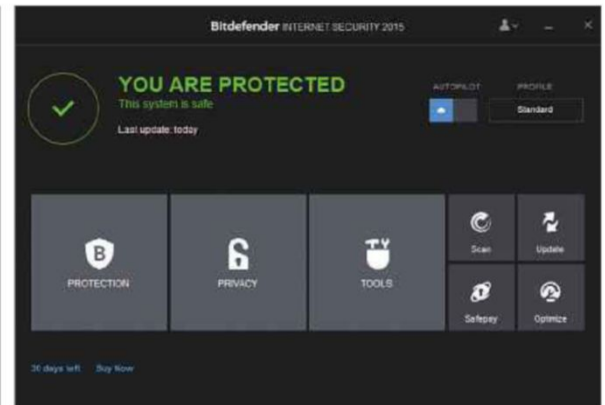
If Bitdefender has one major selling point, it's the range of innovative features it offers.

Aside from basic antivirus protection and an intelligent firewall with easy-to-use rules, it crams in a rescue mode to reboot, clean and fix your system, and web protection with an optional browser toolbar. You also get anti-fraud and anti-phishing protection, a whole raft of privacy tools, a hardened browser for banking and shopping, parental controls and built-in optimisation utilities. It even has a battery mode for use on laptops,

cutting back on non-essential security activities when you're low on charge.

Sometimes it goes overboard: there are seven clean-up, optimisation and Registry tools from which to choose, which is odd given the prominence of the one-click optimiser.

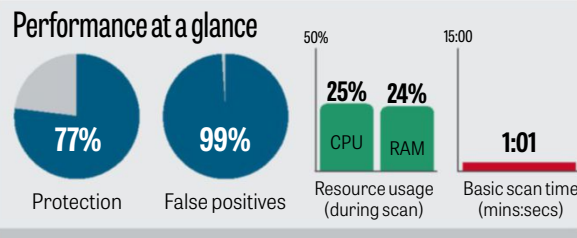
And while we're impressed by Bitdefender's Profiles feature, which postpones notifications, background programs and maintenance tasks while you're working, watching videos or playing games, it's keen to throw up widgets the rest of the time. For example, a splash in the top corner of the screen asks if you'd rather switch to the Safepay browser, and a circular widget in the bottom-right corner provides status notifications and one-click access to the dashboard, where a system-tray applet would work just as well. On the whole, however, the UI is easy to navigate.



ABOVE Bitdefender includes a generous choice of cleanup, optimisation and Registry tools

Quick scans in Bitdefender are extremely fast, taking just over a minute on our old dual-core PC. It's heavier on system resources, consuming an average of 24% of RAM and 25% of CPU while scanning, but the system still felt responsive.

Bitdefender's only real failing is that it doesn't match the best products where it matters most: malware protection. It staved off only 77% of attacks, which puts it just above the free AVG and Microsoft products. On the plus side, it's very good at ignoring legitimate software, but if the price for this is weaker security, then we can't really recommend it.



Eset Smart Security 8

A good selection of tools targeted at those wanting professional-grade protection

SCORE ★★★★★

PRICE 1 PC/1yr, £32 (£40 inc VAT) from pcpro.link/246eset

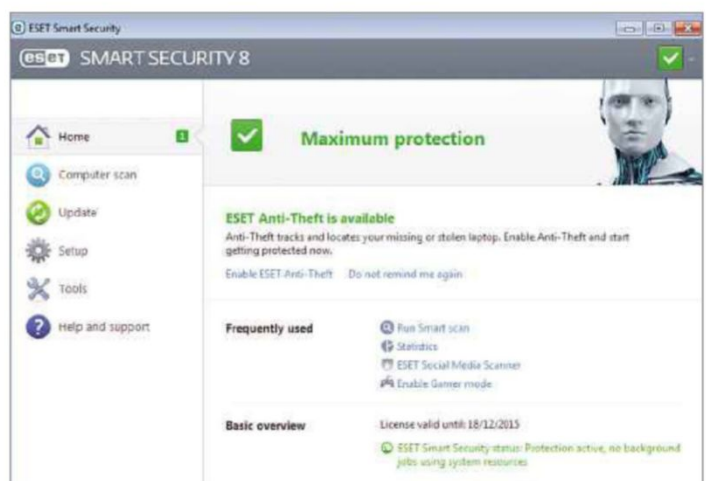
Eset may not have as broad-ranging a feature set as Norton or Kaspersky, but it makes up for this with an efficient UI, exceptional protection, and a host of security-focused tools that power users will appreciate.

The basic anti-malware tools and firewall are backed by anti-theft protection, unobtrusive web-access protection – with anti-spam and anti-phishing. The package's parental controls are optional.

There's a gaming mode that halts pop-ups and pauses scheduled tasks until you've finished playing, and a social media scanner to protect accounts on Twitter and Facebook. Optimisation and cleanup tools aren't included.

The UI adopts a pane-based approach that places the most important information upfront. Malware scans include a basic smart scan that makes intelligent decisions about custom scans and removable media scans, plus where and what to analyse.

Look in Setup, meanwhile, and you'll find options to enable and disable all components, or disable them only for a set time – ideal when you need to temporarily turn off antivirus to install a new application. An Advanced Setup panel allows even more fine-grained control, down to how and when you see notifications and message boxes, and lets you set passwords to protect your configuration. Eset also scores big for its reporting features, and for

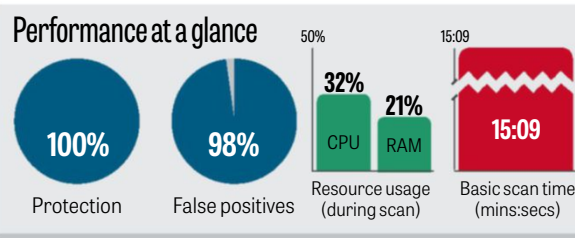


ABOVE Eset's pane-based interface places the most important information upfront

hidden extras such as the ability to scan running processes to tell you whether or not any risks exist.

Eset can be slow when running scans, with our first scan on the ageing dual-core test PC taking more than an hour, although subsequent scans were faster. It's also quite resource-hungry, hogging an average of 32% of the CPU and 21% of RAM during scans.

Luckily, the results are worth it: Eset is the only package here to have defended against every threat in our tests, although it's behind Kaspersky when identifying legitimate software. A great suite for the pros.





McAfee Internet Security

Dated looks and poor performance – this security suite fails to keep up with the competition

SCORE ★★☆☆☆

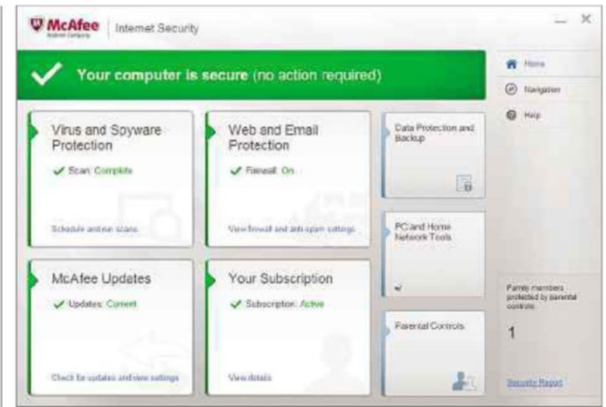
PRICE 3 PCs and 3 mobile devices/1yr, £14 (£18 inc VAT) from pcpro.link/246mcafee

Once Norton's biggest rival, McAfee has been struggling to maintain the pace over the past few years, producing software that hasn't performed well in our malware tests. This doesn't look set to change in the near future.

Features in the latest release are limited by Norton and Kaspersky standards, but McAfee still crams in a firewall, web-protection, anti-spam, parental controls, plus cleanup tools, a vulnerability scanner and a home-network scanner.

These features are individually pretty good. The parental controls, for example, make short work of setting up internet content and search restrictions for specific Windows accounts, and can also be used to restrict access to specified times. The vulnerability scanner does a great job of spotting missing patches and updates, then downloading and installing any Windows updates for you. Although McAfee's SiteAdvisor is available as a free browser plugin, its at-a-glance site ratings are helpful and reassuring.

While the dashboard looks dated, it's perfectly functional, with the major security tools up front and the secondary features sensibly organised. However, the interface feels sluggish and slow to respond. Even the system-tray applet suffers; click on it and you have to wait a

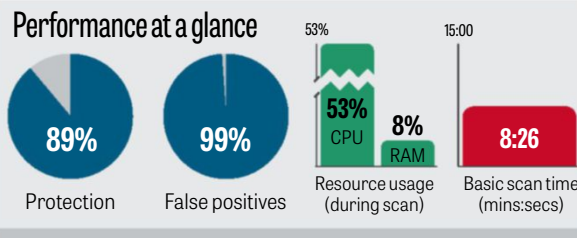


ABOVE The dashboard is sensibly laid out, with the most important tools to hand

second or two to check the status of the current scan.

All-round performance could be stronger. On our old dual-core PC, McAfee took more than eight minutes to complete a quick scan, using an average of 53% of the CPU and 8% if RAM while it did so. In the process it slowed everything else to a crawl.

Is the struggle worth it? Not really. Its protection score was only 89%, meaning that 11% of threats compromised our test systems. McAfee also blocked one of our legitimate applications without so much as a prompt. Overall, this package is a big disappointment.



Microsoft Security Essentials

Simple to use, quiet in operation and unobtrusive, but protection isn't good enough

SCORE ★★☆☆☆

PRICE Free from pcpro.link/246mssecess

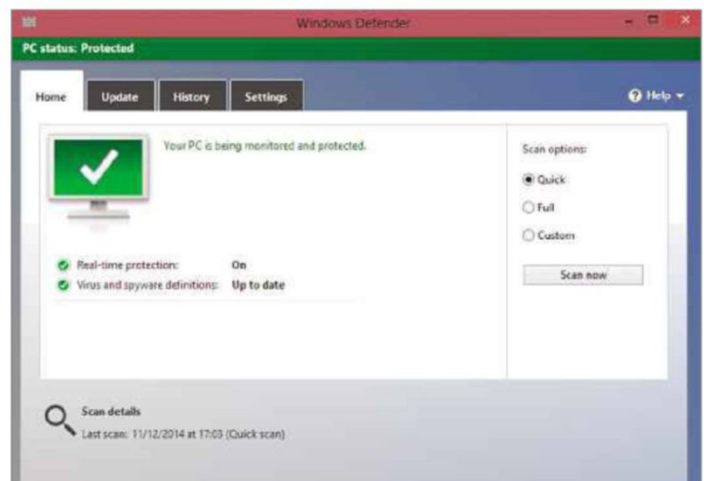
If you use Windows 8, then you may already be using Microsoft's anti-malware package without knowing it; in the guise of Windows Defender, it's the operating system's default antivirus solution. For Windows 7, Vista and XP users, it's a quick and easy download from microsoft.com.

Security Essentials is designed to work with the other security features baked into Windows, including the Windows firewall and the SmartScreen website and download filter, and its biggest selling point is that you normally wouldn't know it's there. It updates automatically through Windows Update, and sends the few

notifications you might see through the standard Action Center in the Windows system tray. It protects in real-time, but also allows scheduled and manual scans, and there's little reason to ever open its control panel.

If you do, however, you'll find a simple interface with a focus on performing quick, full and custom scans, and providing information on whether the signatures are up to date. You can look through the history and see if any quarantined items deserve to be released into the wild, and the settings allow you to exclude certain files, locations, file types or processes, and decide whether or not to scan removable drives.

That's it. It's a deliberately simple anti-malware tool, and speedy too,

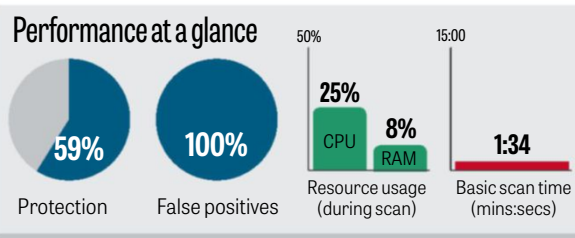


ABOVE Microsoft Security Essentials is simple and speedy at performing full and custom scans

taking around 1min 34secs to complete a scan on our ageing dual-core PC. We also found it light on system resources, not noticeably affecting usability.

The problem is that Security Essentials can't offer real peace of mind. In our tests, Security Essentials allowed the system to be compromised by 41% of threats. Its flawless response to legitimate software boosted its Overall score, but this is still worrying.

With this being the case, we wouldn't trust our PCs and our data to Security Essentials alone. Frankly, neither should you.



Norton Security 2015

A great security package, with plenty of features and a focus on all-round home protection

SCORE ★★★★★

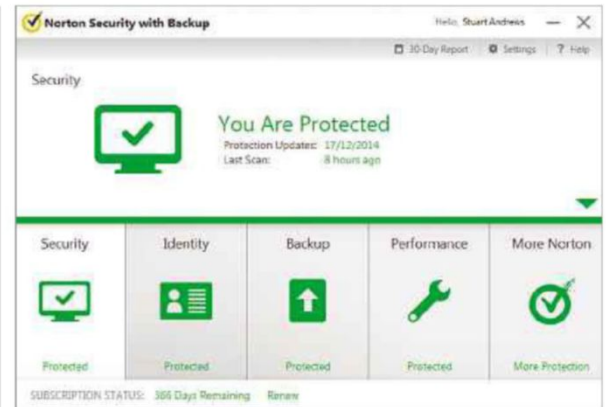
PRICE 5 devices/1yr, £29 (£37 inc VAT)
from pcpro.link/246norton

Norton's security product might not be the cheapest of the major security suites, but it protects up to five devices in one household, including Windows and OS X systems, and iOS or Android smartphones and tablets. It's also one of the more slick-looking packages we've seen: animated slideshows during installation showcase all its advanced features, and its interface is attractive, functional and accessible.

The package certainly crams a lot in, from firewall and anti-malware tools to anti-spam protection, social network protection and a web-based password generator.

There are also optimisation tools for your hard disk, a file cleanup tool and a startup manager. Norton's Safe Web browser toolbar verifies web pages and links while you're searching and browsing, without pushing you towards a specific search engine or browser. Identity Safe stores and retrieves passwords and auto-complete settings from the cloud, linking in neatly with Norton's mobile apps. These include remote-wipe and remote-lock features to protect Android smartphones, as well as app-scanning and anti-phishing protection for the browser.

There's no shortage of scanning options within the main package. You can put Norton Security into a silent mode and switch features on and off with ease. You can also set which actions you want the software to take automatically and where you want to

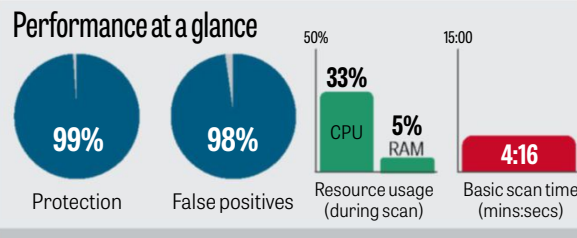


ABOVE Norton Security 2015's packs in an impressive range of features

be prompted. Meanwhile, if your PC falls victim to a particularly nasty infection, Norton's Power Eraser provides an aggressive repair tool.

Norton's antivirus protection is among the best on test, warding off 99% of threats and tending to deflect them rather than neutralise them in place. It isn't quite as hot as McAfee and Kaspersky for avoiding false positives, but the odd prompt to block a legitimate application is something we can live with.

Kaspersky is our first choice, but mainstream users who know and trust the Norton brand name won't go far wrong with this package.



Trend Micro Maximum Security

The updated interface is very likeable, but elsewhere this package lags behind the best

SCORE ★★★★★

PRICE £33 (£42 inc VAT) for 1yr, 3 devices
from pcpro.link/246trend

There aren't many internet-security packages that you can describe as beautifully designed, but Trend Micro Maximum Security qualifies. The installation is slick, with an animated progress meter surrounding explanations of the package's key benefits, and this continues into the UI, which is all oversized buttons, intuitive displays and tasteful fonts. At times form threatens to get in the way of function, but the more you use the package, the more sensible it seems.

It's full of features, too. Even the more basic Internet Security package packs in anti-malware tools, family protection features, anti-phishing

protection and scans to check privacy settings in the major social networks. The Maximum Security edition throws in a secure browser for online shopping and banking alongside a password manager.

Trend Micro's SafeSync tool securely synchronises files between PCs, and a password-protected vault allows you to store sensitive files in the cloud. Features are easy to configure, and introduction pages – which you can prevent popping up in future – explain the purpose of each tool and why you need it.

Elsewhere, detailed reports provide up-to-date information on what the package is doing on your behalf, and even the configuration is user-friendly. There aren't many other security packages on the market that let you choose between "automatic", "normal" and "hypersensitive" protection levels.

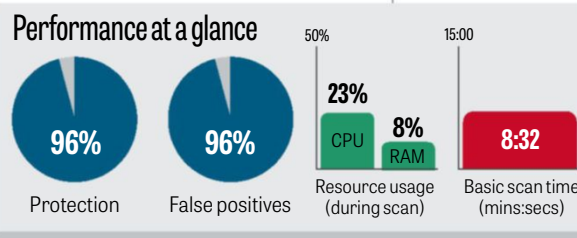
There's some impact on performance, but it isn't too painful.



ABOVE Trend Micro's UI is among the most attractive we've seen

Even on our old dual-core PC, CPU utilisation rarely rose above 50%; most of the time it stayed below 30%. The same is true of RAM. The quick scan took 8mins 32secs, but that included three minutes or so of optimisations, removing unnecessary and unwanted files.

Unfortunately, Maximum Security can't catch the leaders when it comes to protection, warding off only 96% of attacks – a figure that's lower than the free Avast package. We also found it one of the more obstructive packages in everyday use, blocking four legitimate applications from installing without a prompt. A shame, since in every other way it's a pleasure to use.



View from the Labs

Although antivirus software is doing well to keep pace with the rate of threats, **Stuart Andrews** believes there is still room for improvement

There's plenty of reason to feel cheerful about the results from this test. While the malware and internet threats keep coming, antivirus software seems to be developing at a rate that's fast enough to cope. Of the ten packages tested here, six were able to fend off more than 95% of attacks, while four managed protection ratings of 99% or 100%. Given how hard Dennis Technology Labs works to simulate real-world threats, those are excellent results.

Opt for Kaspersky Internet Security, Norton Security, Eset Smart Security or Avast Free Antivirus and you can feel confident that your PC will be infection-free – although you can aid the cause by behaving intelligently and adopting good security practices yourself.

Sadly, some security suites – particularly the free ones – are still struggling. It's a shame to see the once-mighty AVG languishing at the bottom of our league table, but letting 24% of the test malware find a home on our target computer isn't good enough.



Stuart Andrews is a regular contributor, and former PC Pro reviews editor

"We used to say that the free Windows option was perfectly adequate for many users, but not any more"

While we accept that not every PC will encounter the threats that our target systems are subjected to, Microsoft's Security Essentials is also failing as a base level, anti-malware defence. Some 41% of our test malware made it past Microsoft's detection, putting it behind every other option by a significant margin. We used to say that the free Windows option was perfectly adequate for many users, but not any more. If you're using Security Essentials or Windows Defender, we advise you switch.

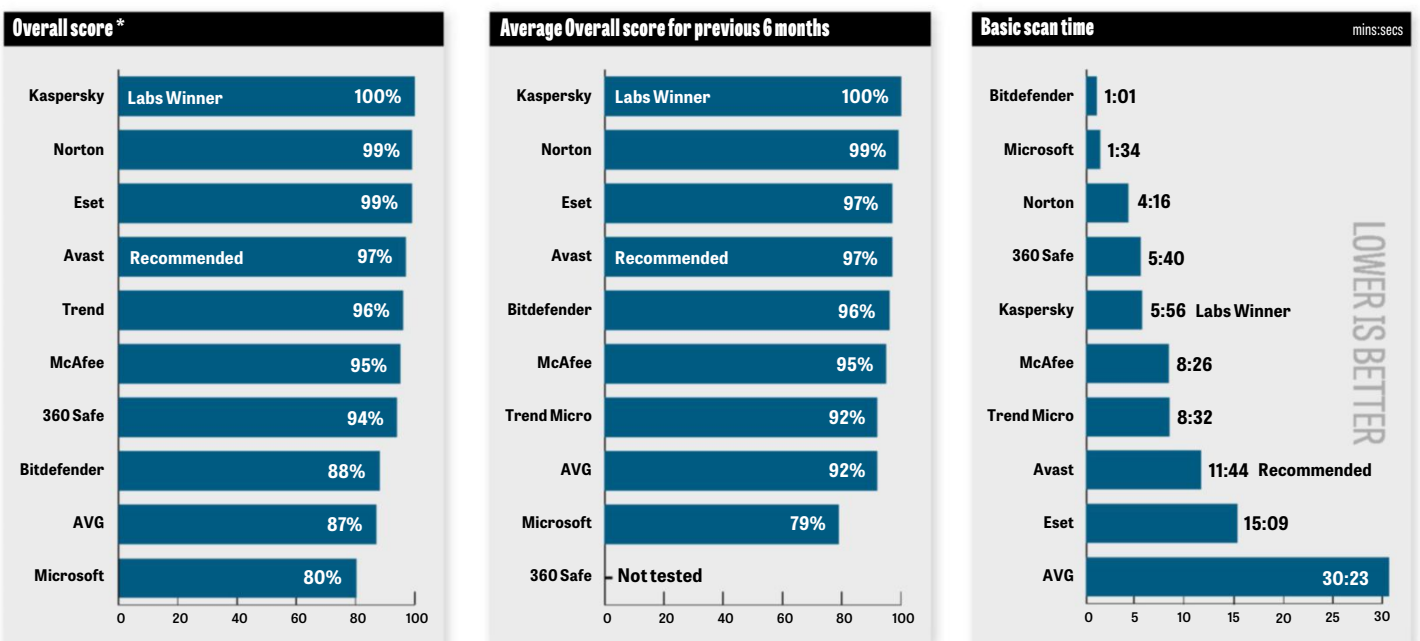
It's becoming more and more obvious that simply recognising and neutralising malware is no longer enough; the best packages on test take a more proactive approach, screening links and websites so users don't come within reach of their malware payload. They're also working much harder to close down vulnerabilities, with most security software now offering features that scan for crucial software updates, and several offering tools to watch for phishing behaviour

or privacy risks both on the open internet and on social networks.

There are still areas where we'd like to see improvement, however. One of the reasons Microsoft Security Essentials is the package of choice for many is because it's unobtrusive, working quietly in the background and rarely troubling the user for any intervention. A number of products on test ruined their chances of gaining a recommendation by preventing perfectly legitimate software from installing, by hijacking browsers and switching search engines, or by demanding user interaction where none should have been needed.

Others still have too high an impact on system performance, or seem more focused on upselling to a premium version than delivering protection with the one you've already installed. This is why Kaspersky Internet Security remains our choice of security software: not only does it provide great protection and all the options and features we could ask for, but it does so in a no-nonsense, fuss-free manner. ●

Test results



Everything you'll ever need to know about **Windows 8**

MAGBOOK

MAGBOOK

THE ULTIMATE GUIDE TO **Windows**

8

For
laptops,
tablets
and PCs

Start



Step-by-step guides
Over 150 pages of expert advice

Easy upgrades
How to transfer files
from Windows 7

Secret extras
Hints, shortcuts
and hidden tools

Stay secure
Block viruses and
protect your data

From the
experts at
PC Pro

ON SALE NOW

Order your print or digital copy direct
from **magbooks.com** or call on **0844 844 0053**

Magbooks cover a range of topics from IT, Motoring to Fitness and Lifestyle

ONLY £7.99

The Network



Practical buying and strategic advice for IT managers and decision makers

Business Focus

What to look for when buying a multifunction printer **p98**

The Business Question

How CRM can transform your business **p106**

Cheat Sheet

SaaS: your security needs delivered via the cloud **p108**

BUSINESS FOCUS

Choose the right MFP for your business

A business printer isn't just about fusing toner onto a page. **Dave Mitchell** explains how the right model will improve quality, workflow and costs



Let's be honest: the paperless office may never happen. Businesses of all sizes need printers because people still want to print everything from boarding passes to emails to 60-page reports. But there is a need to reduce printing, driven by both environmental considerations and operating costs.

The most practical short-term solution for businesses is to take control of employees' print output, and this is where the modern-day multifunction printer (MFP) has a pivotal part to play.

The good news is that increased demand for MFPs has resulted in huge reductions in price, making colour printing affordable for even the smallest business. In this month's buyer's guide, we look at five colour MFP solutions that go beyond the basic 4-in-1 remit and offer a wealth of document-management features.

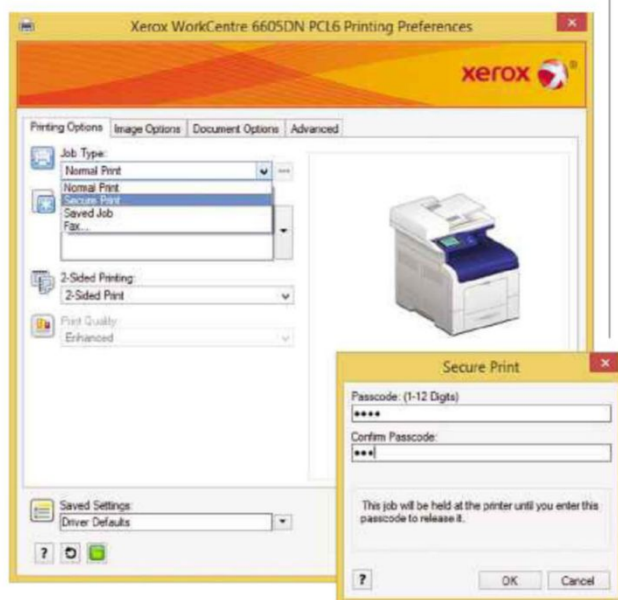
Paper trail

Combining print, scan, fax and copy functions into a single unit gives businesses more choice over how they handle documents. If they need to be printed out or copied, fine, but if not you can use an MFP to cut down on wastage by digitising documents.

All the MFPs on review feature high-quality colour flatbed scanners, but it's what they let you do with your scanned documents that's more interesting. For instance, you can scan straight to email, with an address book available on the printers for swift selection; even the smallest one can store 100 entries.

Want to scan direct to fax? No problem, since all six MFPs on test

BELOW The Xerox WorkCentre's secure print function enables users to control when a print-out is released via a PIN



have built-in fax/modems. All the models here even allowed us to scan directly to network shares or FTP servers for document storage.

Even if you do need to copy straight to paper, newer models tend to include duplex (double-sided) printing as standard, since it's less wasteful and therefore cheaper.

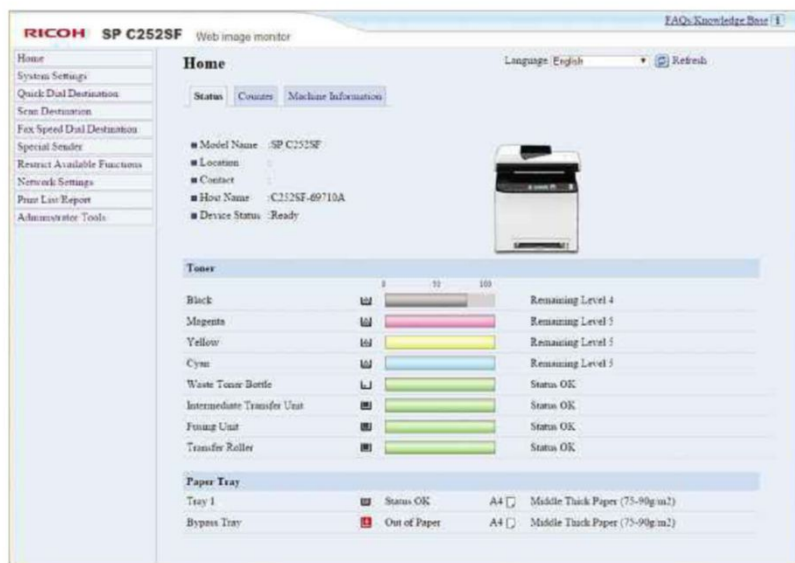
Cloud control

Relatively new is the ability to send documents to the cloud. Brother wins hands down in this regard: it supports a range of service providers including Box, Google Drive, Evernote, Dropbox and OneDrive.

Epson isn't far behind: registering our accounts was simple, and once authenticated, they appeared as scan destinations in the control panel, making document uploading easy.

Oki and Ricoh lag behind in this area, while Xerox uses the cloud only to provide printer-management services: its Mobile Print Cloud portal is designed for big businesses, with printers spread across multiple sites.

All business-focused MFPs include wired network support, and many include wireless support too. Just note that you may only have the



LEFT Keep a close eye on the Ricoh's consumables from its tidy web interface

option of using one at a time, and the HP and Xerox models will require you to buy a wireless module.

Laser, LED or inkjet?

The biggest decision will undoubtedly be which print technology to opt for. High-volume print environments have traditionally favoured lasers or LEDs, but inkjets are attacking this domination with fervour. If you're still attached to the notion that inkjets are for home offices only, the products on test here should be a wake-up call.

Take the perception that inkjets have low monthly duty cycles. While this used to be true, Epson's WorkForce Pro WF-5620DFW and Brother's MFC-J5720DW deliver respective maximum monthly duty cycles of 35,000 and 30,000 pages.

Along with bigger ink tanks, both offer high resolutions, making them ideal for printing marketing material and photos. Brother's device goes further: it has three input sources, all supporting A3 paper, and yet it costs only £162 – almost ten times less than the cheapest A3 colour laser MFP.

As a rule, laser and LED printers win for speed, as they can maintain their pace regardless of what's on the page. For example, Brother claims a laser-beating 35/27ppm for mono/colour but, as we found, this can be achieved only in Draft mode. HP's Officejet Pro X Series tops out at 70ppm, and managed 40ppm in our tougher DTP test.

Lasers and LED printers also cope better with variable paper quality, being able to print on pretty much anything. Using cheap photocopier paper in an inkjet will result in the paper wrinkling while it dries out.

Power to the printer

An environmentally friendly office not only saves paper – it also saves power. Lasers have a reputation

for their heating and fusing components being far more resource-hungry than inkjets.

We measured power consumption throughout our tests and recorded the Epson and Brother inkjets drawing a mere 22W and 14W in use. All six MFPs offer a Sleep mode, and it was the Xerox device that recorded the highest draw in this mode at 5W, with the rest sipping only 2 to 3W.

Oki claims its LED technology uses less power than laser technology, but this doesn't necessarily mean that LED-based printers will always be the lowest consumers. Ricoh's SP C252SF pulled a maximum of 1kW during printing; Xerox's WorkCentre 6605DN peaked at 1.14kW; and Oki's MC562dnw drew 1.17kW.

Think security

If you buy a high-quality printer, then you may find it becomes an attractive tool for employees' personal use. If you'd like to curb such use, you should turn to the range of access controls on offer. For example, Brother's Secure Function Lock 2 controls access to key MFP features such as colour printing for a maximum of ten users, and can set page limits too.

Oki offers similar features, but forces all users to log in at the printer or from the driver to use any feature. Xerox's Copy Lock and Scan Lock stop unauthorised users from accessing the scanner, but the Secure Access option is expensive: it requires a USB swipe card reader

“High-volume print environments have traditionally favoured lasers and LEDs, but inkjets are on the attack”

installed on the printer alongside a link to an authenticated server.

To protect confidential documents, Epson, HP, Oki, Ricoh and Xerox offer a secure print function in their Windows drivers. This enables users to assign a PIN to a particular job, so they can walk up and enter it at the control panel to release the print-out.

While we're all aware that used toner and ink cartridges should be disposed of responsibly, the same is true of your MFP when it reaches end of life – make sure you erase any confidential information stored on it.

However, one of the demo printers supplied for testing hadn't been cleared after previously being used by a large travel company. After beginning testing, we soon realised that its

internal address book still contained a long list of private company email addresses alongside fax details of their bank and customers.

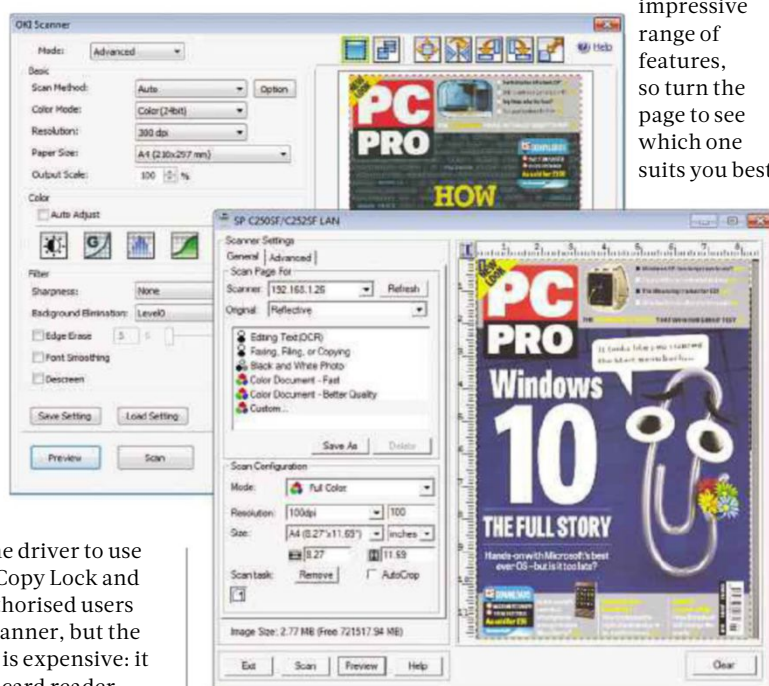
Go forth and scan

Small businesses looking to streamline printing processes and reduce paper usage will find an MFP an invaluable ally, since it combines all the hardware needed into a desktop-sized unit. Furthermore, all the MFPs on review here are affordable and their running costs likely to be a significant improvement on your current equipment.

The paperless office may still be a pipe dream, but an MFP provides businesses with the tools they need to lessen their impact on the environment and reduce paper usage. Whether you choose inkjet, laser or LED, they all offer an

impressive range of features, so turn the page to see which one suits you best.

BELOW Each printer has a TWAIN driver for grabbing remote scans direct to the desktop





Brother MFC-J5720DW Business Smart

Great value and beats the rest for cloud features – but print quality and speed aren't its strong points

SCORE ★★★★★

PRICE £169 exc VAT from printerland.co.uk

The MFC-J5720DW is the largest model in Brother's new J5000 Series of inkjet MFPs, and it packs in a superb range of features at a giveaway price. It touts fast mono and colour speeds, laser-trouncing running costs, wired or wireless operation and automatic duplexing.

Its dual 250-sheet lower trays are partnered by a rear multipurpose tray, and the real clincher is that all three support A3 paper. Brother has also improved build quality: the trays are sturdier than the manual feed supports we criticised on the MFC-J4710DW (pcpro.link/246brother).

Forget any preconceptions you may have about inkjets being more expensive than lasers: so long as you opt for the XL ink cartridges, mono and colour pages work out at 0.8p and 3.8p per page. The printer comes with standard cartridges, but there's no benefit to buying more at this capacity since they push up page costs to 2.3p and 7.3p.

The printer's colour touchscreen is easy to use, with chunky icons to show scan, copy and fax operations. It also provides swift access to an array of cloud features, with options for

Box, Google Drive, Evernote, Dropbox, Facebook, Picasa, Flickr, OneNote and OneDrive.

Setting up access is a cinch: we selected Google Drive, entered the unique registration code provided by Brother's cloud portal and enabled PIN-protected access. We uploaded images from the scanner and a USB stick to our account, browsed our cloud folders and picked files to print or save to USB. Simple.

Brother's web-based UI provides effortless access to the printer's other features – for example, monitoring consumables and creating a 100-entry fax address book. With LDAP enabled, we were able to browse a list of Active Directory users from the printer and send emails and faxes to them.

We created scan profiles for FTP servers and network shares, and used the Windows Control Center 4 utility to access copy, scan, OCR and fax functions from the desktop. Scan operations can also be linked directly to local apps such as email.

Wired and wireless modes are set from the web interface, but note that both can't be active simultaneously. While NFC isn't supported, Apple AirPrint worked fine with our iPad, and Brother's nifty iPrint&Scan mobile app let us print directly from our photo album and any registered cloud services.

Alas, we couldn't match Brother's claimed 27ppm print speeds in our tests. Our 27-page Word document was delivered at 21ppm using the driver's Fast mode, 15.5ppm at Normal and 1.7ppm at Best mode. Likewise, our colour 24-page DTP print returned



ABOVE Build quality has been improved over previous models

only 1.4ppm in Best mode, while a high-resolution A3 poster crawled out in around six minutes. Duplexing is also tardy: a 24-page Word document printed at a noisy 6ppm.

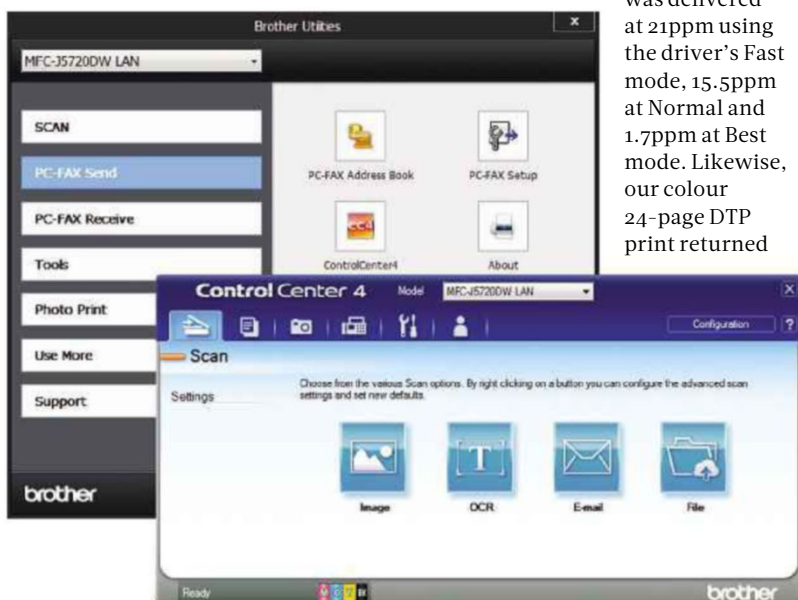
The scanner produces excellent results, but its ADF is noisy, and slow, with a ten-page copy in Normal mode returning mono and colour speeds of 11ppm and 8.5ppm.

Output quality varied significantly across different paper weights. We found Fast and Normal modes on low-cost 90gsm paper were only good enough for draft copies since text was slightly fuzzy. Heavier, 100gsm paper produced sharper text, and although colour graphics and photos were more detailed, they were still pallid and lacking in contrast. Glossy photo

paper produced far superior detail and vivid colours, but some bleeding along the edges was evident and the print heads left unsightly scuff marks on the surface.

The MFC-J5720DW takes some beating in the value stakes, but its average print quality and low speeds compromise its scores. It wins out for paper flexibility, though, with A3 support across the three main paper sources. Plus, its cloud features are among the best here and printing costs are commendably low.

“Wired and wireless modes are set from the web interface, but note that both can't be active simultaneously”



LEFT Brother includes plenty of useful tools, including utilities to remotely scan documents and email, OCR or save them manually

SPECIFICATIONS

6,000x1,200dpi A4/A3 inkjet • 2,400dpi colour flatbed A4 scanner • 35/27ppm mono/colour • 2x USB 2 • 802.11n Wi-Fi • 33.6Kbits/sec fax/modem • 2x RJ11 • duplex • 2x 250-sheet A4/A3 input trays • 50-sheet ADF • 490 x 345 x 308mm (WDH) • 1yr warranty
RUNNING COSTS XL cartridges: mono (2,400 pages), £19 • CMY (1,200 pages), £12

Epson WorkForce Pro WF-5620DWF

An A4 inkjet MFP ideally suited to heavy hitters who want low running costs and classy cloud service support

SCORE ★★★★★

PRICE £235 exc VAT from printerland.co.uk

Think inkjets are only good for low-demand use? Epson's WorkForce Pro WF-5620DWF shatters this myth, with a monthly duty cycle of 35,000 pages. What's more, it uses the same PrecisionCore print-head technology as Epson's commercial printers and its high-capacity cartridges keep it running for longer.

Epson has a firm eye on costs too. That £235 exc VAT price is no typo, while running costs for the XXL cartridges (each with a 4,000-page capacity) are among the lowest in this class: expect to pay only 1p per mono and 4.4p per colour page.

Epson's installation software has every angle covered. It provides a tutorial on setting up the printer and, when we were ready, it loaded the drivers, downloaded the latest firmware and installed an E-Web Print browser plugin plus desktop scan and fax utilities.

The only annoyance was having to run a head-clean cycle before testing, but with the gaps in the nozzle-pattern test now filled in, the printer proceeded to deliver good speeds and quality. In Draft and Standard modes, our 20-page Word

document was delivered in one minute (matching Epson's claims) while the High-quality mode dropped speed to 10.5ppm.

Colour printing is slower: our 24-page DTP test print returned 18ppm in Standard mode and 10ppm for High-quality. Even so, the time to first page was fast – we rarely had to wait more than eight to nine seconds for any of our test prints.

The scanner is a simplex version, but its ADF copies both sides of a document by reversing each page automatically. Speeds are a little slow, though, with a single-sided 15-page mono document copying at 7.5ppm at Standard and 6ppm in Best mode.

It's best to stick to Standard mode for text printing, since it produces the sharpest results; Best mode leaves a slight dusting on some characters. The latter delivers the goods for printing graphics and photos, however, with bold, punchy reports and sharp, glossy photos without any banding or bleeding at the edges.

Epson Connect enables remote users to email print jobs as attachments to the printer. After registering, we were provided with a unique email address for the printer and, from the web portal, we created approved-sender lists and decided which features they were allowed to access. Wired or wireless operations are available, as are AirPrint and Wi-Fi Direct, while pretty much every cloud service we can think of is supported.



“Wired and wireless operations are available, while pretty much every cloud service we can think of is supported”

BELOW Epson's XXL ink tanks last for 4,000 pages – monitor their contents from the printer's web UI

Nor is cloud support only a feature Epson has casually ticked off: we couldn't believe how easy it was to enable the scan-to-cloud service. From the Connect portal, we added our Google Drive account; after authentication, it immediately became available in the printer's control panel as a scan destination.

LDAP was just as easy to use, as we discovered on adding our Active Directory (AD) server along with authentication details and a search base. From the printer, we could then search for AD users and add them to the address book as email and fax contacts.

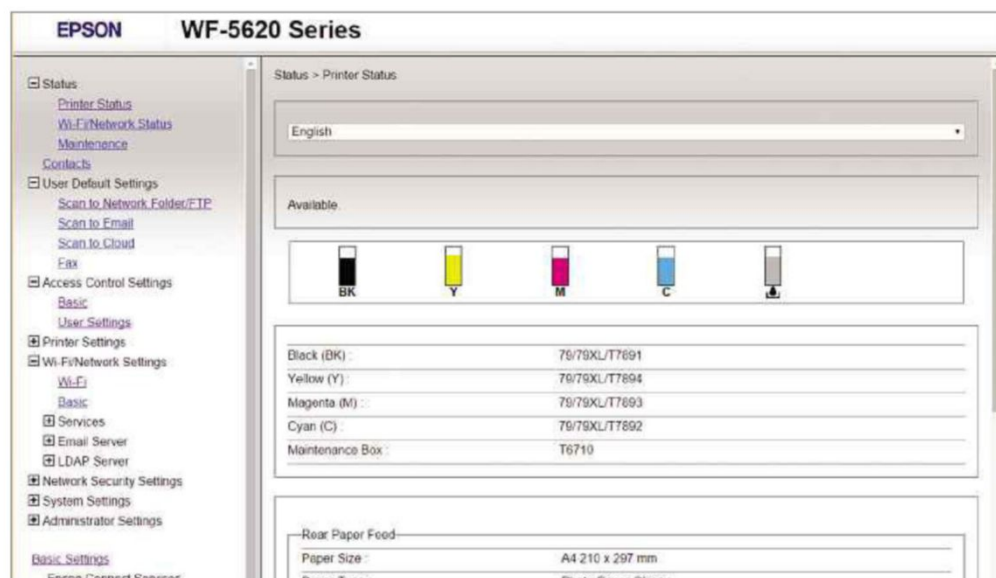
The colour touchscreen makes light work of scan, copy and fax functions. With Epson's software tools loaded on a Windows 7 client, we could also run remote scans, maintain a local fax phone book and upload a speed-dial list to the printer's address book.

There's plenty we like about the WF-5620DWF: it's cheap to run, has tons of features and is very user-friendly. It puts forward a compelling argument for inkjets in the workplace, and therefore takes a well-deserved place on the A-List.

SPECIFICATIONS

4,800 x 1,200dpi A4 inkjet • 1,200 x 2,400dpi colour flatbed A4 scanner • 20ppm mono/colour • 2 x USB 2 • Gigabit Ethernet • 802.11n Wi-Fi • 33.6Kbits/sec fax/modem • 2 x RJ11 • duplex • 35-sheet ADF • 461 x 442 x 342mm (WDH) • 1yr on-site warranty

RUNNING COSTS XXL cartridges: mono (4,000 pages), £40 • CMY (4,000 pages), £45





HP Officejet Pro 8620

A low-cost inkjet MFP with useful features, good colour output and laser-trouncing running costs

SCORE ★★★★★

PRICE £136 exc VAT from misco.co.uk

You might not expect low-cost inkjets to hold much appeal for businesses, but HP's Officejet Pro 8620 turns that perception on its head. Despite its low price, this A4 inkjet prints, scans, faxes and copies; it has web and mobile printing abilities to rival its more expensive brethren; and it does all of this with far lower running costs than a laser.

HP's XL ink cartridges deliver a mono page for 1p and a colour page for 4p, similar to those of the Epson WorkForce Pro (see p99). The only potential irritation is that HP's cartridges last for around half the page count of those of Epson.

The 8620 can't compete with the lasers for speed: it's rated at only 21ppm for mono and 16.5ppm for colour, using the driver's Normal setting. Sending a 25-page Word document to the HP saw print speeds hit 22ppm, but this figure dwindled to a sluggish 5.2ppm when we switched to Best mode. Similarly, our 24-page colour DTP document returned 14ppm in Normal mode but only 3ppm at the highest quality. For all tests we found that the time to first page was around 12 seconds. (If you want laser-like speeds in an inkjet, and don't require a fax or scanner, take a look at HP's Officejet Pro X Series.

Visit pcpro.link/246hpp for our review.)

The 8620 can turn its hand to standalone copying, but again, it won't win any prizes for speed. In our tests, a ten-page mono copy sent through its 50-page ADF dropped into the output tray at a rate of 9ppm. Handily, there's a clip-on duplex unit at the rear, but copying the same document to a double-sided print pushed speeds down further to 8ppm.

Print quality is variable. We found text looked slightly fuzzy in Normal mode, but noticeably more crisp in Best mode. Mono photos printed at the Normal setting were equally uninspiring, and suffered from unsightly banding and poor levels of detail. Upping the print resolution did little to improve matters.

Where this printer wins is with colour output. The 8620 churned out punchy marketing reports with bold charts and graphs – the only limitation is that you'll need to shell out for good-quality paper if you want to avoid wrinkly prints. But, of course, the 8620 does one thing that lasers can't, and that's print high-quality colour photos on glossy paper.

The 8620 is jam-packed with features. The large 4.3in colour touchscreen gives quick, easy access



to all the main functions, and there's support for both wired and wireless printing via Apple AirPrint, Wi-Fi Direct and NFC connections. Scans can be sent to an email address or a network share, and HP provides a tool for remote scanning from a PC.

HP's cloud integration is good, but not quite on a par with that of Epson, which offers superior support for Google Drive, Dropbox and other cloud services. For instance, the HP will work with Google Drive, but we found we had to manually configure this from our Google account; Epson's software does this automatically.

HP focuses more on its Connected service, which assigns an email address to the printer and thereby makes it possible for anyone to send

messages to it and have attachments printed automatically. This is similar to Epson's Connect service, since it also lets you decide which senders can use the service, print using colour and so on.

The Officejet Pro 8620 packs in a generous range of printing options at a good price. Print speeds are slow but, crucially, it scores well for its superb colour output, low running costs and wealth of useful features.

"The Officejet 8620 does one thing that lasers can't – and that's to print high-quality colour photos on glossy paper"

SPECIFICATIONS

4,800 x 1,200dpi (optimised) A4 inkjet • 1,200 x 1,200dpi colour flatbed scanner • 21/16.5ppm mono/colour • 2 x USB 2 • 802.11n Wi-Fi • 33.6Kbits/sec fax/modem • 2 x RJ11 • duplex • 50-sheet ADF • 505 x 407 x 315mm (WDH, with tray out, duplexer detached) • 3yr warranty
RUNNING COSTS XL cartridges: mono (2,300 pages), £22 • CMY (1,500 pages), £15

LEFT HP's Printer Assistant is easy to use and comes complete with estimated ink levels



Oki MC562dnw

Top-quality output and good print speeds, but the MC562dnw is comparatively expensive to run

SCORE ★★★★★

PRICE £471 exc VAT from printerland.co.uk

Businesses wanting to see the big picture will love Oki's LED printing technology. It uses fewer moving parts than a laser and the flat paper path in the MC562dnw allows it to handle heavier 220gsm media and print banners up to 1.32m in length.

To realise your banner headlines, you open up the front multipurpose tray and rear output slot to allow a clear run straight through the printer. It works well. Another plus point is that the MC562dnw delivers the characteristic vibrancy and high levels of detail we've seen with other Oki colour LED printers.

Text quality, even at the smallest sizes, is pin-sharp, while colour photos and graphics are punchy, with excellent contrast and detail. Oki's PS3 driver produces vibrant colours, although our performance chart showed it up as a tad overenthusiastic with magenta, leaving a slight pink tinge to mono photos.

The driver's Photo Enhance setting delivers improvements in quality, upping the sharpness and contrast, and as a result giving colour photos real depth. Just note that one of the few drawbacks of LED printing is a perceptible

cross-hatch effect evident in large areas of single colours.

The MC562dnw's printing costs are a little high. The four high-yield cartridges, drum, belt and fuser combine to deliver a mono page for 1.7p and colour for just under 9p.

It can't be faulted for performance, however, with a 30-page Word document whizzing through on both Standard and Enhanced driver settings in 59 seconds. The Oki also shrugged off our 24-page DTP colour test, returning it at 26.5ppm, at both high-resolution and top 2,400dpi ProQ settings.

The scanner also performs well, with colour copies of a glossy magazine cover looking close to the original. Its ADF kept up the good work, with a 15-page copy timed at 22ppm, while a duplex-to-duplex copy managed 6ppm.

The printer's basic web interface isn't as well featured as the TopAccess version on Oki's B700 Series of LED printers. General printer settings such as wired or wireless operations can be set up from here, but no options are provided for controlling user access to print, scan and copy functions.

LDAP support allowed us to use the printer's mono LCD control panel to search our Active Directory server for email addresses to use as scan destinations. The search process is made easier by the full Qwerty keyboard lurking beneath the printer's flip-up job macro panel.

Cloud services are thin on the ground: only Google Print is supported. AirPrint is enabled out of the box and we experienced no issues using it with our iPad 4; however, note that the Oki-recommended ePrint app from Microtech isn't free.



ABOVE The Oki supports 1.32 banners and duplex-to-duplex copying

We used Oki's Configuration Tool to remotely manage the printer's list of fax speed-dials and email addresses. We also created profiles defining scanning destinations for network shares, plus FTP and HTTP servers. The MC562dnw comes as standard with a 4GB SDHC memory card installed. This is accessed from the Storage Manager desktop plugin, where we viewed its contents and uploaded custom fonts and forms.

PCs running Oki's ActKey utility automatically become remote scan

"Text quality, even at the smallest sizes, is pin-sharp, while colour photos and graphics are punchy, with excellent contrast"

destinations that can be accessed from the printer's control panel. After defining ActKey applications, a scan folder or a PC-Fax destination, we could send scanned images directly to any

of these locations.

Oki's MC562dnw's LED engine delivers top-quality colour prints. It has a good turn of speed, but its above-average running costs and minimal cloud service support stop us short of recommending it.

SPECIFICATIONS

1,200 x 600dpi colour A4 LED printer • 1,200dpi colour flatbed A4 scanner • 30/26ppm mono/colour • 2 x USB 2 • 10/100 Ethernet • 802.11n Wi-Fi • 33.6Kbits/sec fax/modem • 2 x RJ11 • 4GB SDHC card • duplex • 50-sheet ADF • Nuance PaperPort SE 11 and OmniPage SE 16 software • 427 x 444 x 509mm (WDH) • 3yr on-site warranty

RUNNING COSTS High-yield: mono (7,000 pages), £78; CMY (5,000 pages), £119



LEFT The desktop Configuration Tool provides a handy status monitor and remote access to the printer's address book

Ricoh SP C252SF

A basic set of features, but this no-nonsense colour MFP is cheap to buy and offers very low printing costs

SCORE ★★★★★

PRICE £308 exc VAT from printerland.co.uk

At £308 exc VAT, Ricoh's SP C252SF immediately scores points for price, but you only need to glance at its mono LCD control panel to see that features aren't its strong point. What you do get, however, is a competent colour A4 MFP with 4-in-1 print, copy, fax and scan options, wired and wireless operation, and exceptionally low running costs.

Even using standard high-yield inks, print costs are reasonable: mono and colour pages cost 1.6p and 7.5p respectively. These numbers improve if you use Ricoh's new ultra-high-yield cartridges, which reduce costs to 1.1p and 6p.

The printer sits comfortably on a desk, and claims speeds of 20ppm for colour and mono prints. Its 250-sheet paper tray has a single-sheet bypass slot and can be supplemented with a 500-sheet lower tray.

Installation could be smoother. After finding the printer on our network, the utility loaded only Ricoh's PCL6 and TWAIN drivers. We had to run it again for the PostScript 3 driver and then for a third time to load the LAN-Fax driver for desktop faxing.

The printer's 200-entry address book can be set up from the control panel or, more easily, from its web UI. We created scan destinations to FTP servers, network shares and email

addresses, which are accessed from the control panel using their assigned speed-dial numbers.

Businesses with an eye on security will appreciate Ricoh's extra features. Using the PCL6 driver, we locked print jobs with a PIN and walked to the unit to release them (this also helps to prevent pile-ups of forgotten print jobs). If you want to control access to more expensive printer functions – such as colour printing and copying – then the Restrict feature requires users to enter a registered name to access such operations.

That's where the good news on features ends. While both wired and wireless modes are available, both can't be active simultaneously. The printer doesn't support Apple AirPrint or NFC, either. Scanning to or printing from cloud services may prove difficult, with poor support compared to rivals. Ricoh's Smart Device Print&Scan app allowed us to view our Dropbox and Google Drive accounts from an iPad, and we successfully printed files from them too, but this printer doesn't support the app's Scan Import function.

The 600dpi print engine and driver "magic up" higher resolutions using gradations of 1 bit per pixel in Fast mode, 2 bits for Standard and 4 bits for Fine. The first two modes returned a 20-page Word document at 20ppm; Fine mode halved speed, and automatic duplexing at Standard mode saw 9ppm.

Colour proved more challenging, with our 24-page DTP test print returning only 10ppm in Fast mode and a tedious 4ppm in Fine mode. Quality is good, however, with photos showing vivid colours, high levels of detail and imperceptible banding; our colour-performance chart revealed



ABOVE Print jobs sent to the Ricoh C252SF can be locked using a PIN

smooth transitions across complex colour fades in Fine mode. Text at Standard and Fine modes was pin-sharp, while mono photos revealed good detail in darker areas.

The time to first page was around 14 seconds, increasing to 20 seconds for colour prints in Fine mode. A Deep Sleep mode reduces power usage to less than 3W, but the printer takes 30 seconds to wake from this mode.

Copying was handled deftly, with the 50-page ADF printing our sheaf of 30 bank statements at an average of 17ppm. Although duplexing requires pages to be turned over and rescanned, we couldn't complain about the output quality, with copies almost

as good as the originals.

The lack of cloud features and slow colour speeds count against Ricoh's SP C252SF, but it claws back points for low running costs and good output quality.

Businesses looking for a no-frills colour laser MFP should place this printer on their shortlist.

"The printer's 200-entry address book can be set up from the control panel or, more easily, from its web interface"



LEFT Ricoh provides excellent user controls, allowing you to restrict what MFP functions individuals can access

SPECIFICATIONS

600dpi A4 colour laser • 1,200dpi colour flatbed A4 scanner • 20ppm mono/colour • 2 x USB 2 • 10/100 Ethernet • 802.11n Wi-Fi • 33.6Kbits/sec fax/modem • 2 x RJ11 • duplex • single-sheet bypass slot • 50-sheet ADF • Presto PageManager 9 SE software • 420 x 493 x 460mm (WDH) • 2yr warranty
RUNNING COSTS Ultra-high-yield toner: mono (6,500 pages), £69 • CMY (6,000 pages), £98 • waste toner bottle (25,000 pages), £17



FOR THE LIFE OF YOUR DOCUMENT

UNCOMPROMISING SUPPORT EVERY STEP OF THE WAY

KYOCERA Document Solutions is a specialised team of people who provide sustainable printing solutions. Expert in the field of document management solutions, our reliable teams deliver an efficient and caring approach to organisations across the public, private and third sectors.

Our customers benefit from the economic benefits of reduced Total Cost of Ownership (TCO), robust hardware and best-of-breed software, along with award-winning apps designed for business.

KYOCERA provides the secure storage, transfer and output of your vital information, future-proofing your important documents.

For the life of your document – whatever your business.

kyoceradocumentsolutions.co.uk

Eldon Court, 75-77 London Road, Reading, RG1 5BS

Call: 08457 103104 Facebook: KYOCERADocumentSolutionsUK Twitter: @KYOCERADUK

Xerox WorkCentre 6605DN

Big and bold – the 6605DN remains a great choice for businesses with a paper-hungry workforce

SCORE ★★★★★

PRICE £434 exc VAT from printerbase.co.uk

The 6605DN is one of the longest-serving members of Xerox's WorkCentre family of colour laser MFPs, but with age has come wisdom: it's beautifully built; it's fast and cheap to run; and busy workgroups will love its hefty 80,000-page maximum monthly duty cycle.

Tipping the scales at almost 33kg, moving it is a two-person job – but once on the desktop, we had it up and running inside 30 minutes. After loading the PS3 and PCL6 drivers, we visited the printer's CentreWare web console to set up scan, fax and email functions.

Via the console you can also set up address books, covering fax speed-dial lists, users, groups, email addresses, network shares and FTP sites. These are stored on the printer, so users can walk up and send or copy documents by browsing destinations on the control panel.

We remotely updated the printer using a desktop utility that allowed us to view the address book and upload new entries. We were able to use the TWAIN driver to acquire network scans to the desktop, but note the Express Scan Manager utility only works with a direct USB connection – as does the printer's Scan-To-PC option.

For direct scanning to email, we entered our mail-server details from the CentreWare console. We also used LDAP to import Active Directory users so we could search for them directly from the printer's touchscreen for faxing and emailing documents.

Xerox hasn't forgotten mobile users. The 6605DN supports Apple AirPrint, while the Xerox Print Portal app allowed us to print to and scan from the printer using our iPad 4. The downside is that it uses Xerox's Mobile Print Cloud portal, which isn't free and requires a cloud-connection agent permanently loaded on a PC on the same network as the printer.

More positively, the portal let us enforce access controls and make available multiple printers across different sites to logged-in users. It also assigns an email address to the printer to enable remote users to mail print jobs as attachments to it. The printer doesn't directly support any cloud services, but the Cloud Connector in the Nuance software bundle has options for more than 30 global services.

The 6605DN is fast, spitting out a 35-page Word document in one minute at both the PS3 driver's Standard and Enhanced settings. Our 24-page DTP colour test print managed a slower 29ppm and 22ppm, but the time to first page never exceeded ten seconds.

Xerox scores for print quality, producing razor-sharp text and high levels of detail in mono photos. Colour photos using the PS3 driver are equally detailed with good contrast and bright colours and only minor evidence of banding. Our colour performance chart showed the PCL6 driver delivering slightly duller primary colours,



which reduced the impact of our marketing brochures.

The scanner returned good results: colour photos and glossy magazine covers revealed plenty of detail and good colour rendition. Its ADF performed well, too, with a 15-page mono copy managing 18ppm, while a colour copy returned 11.4ppm.

Xerox's high-yield cartridges deliver low running costs of 1.3p per mono page and 7.8p for colour. If you stick with the recommended 5,000-page monthly duty cycle, the image drum and transfer unit should last

the life of the printer – but replacing them only adds 0.5p to your page costs.

The Xerox WorkCentre 6605DN may be an old-timer, but it has the legs to keep up with more recent laser

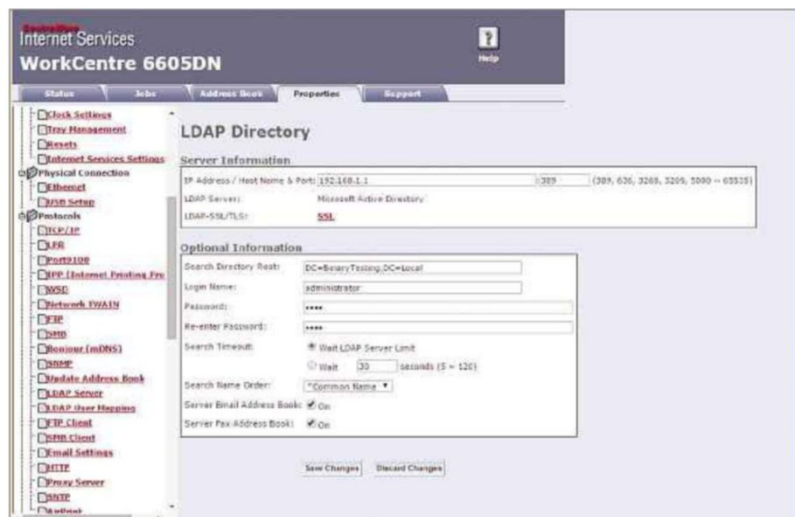
“We remotely updated the printer using a desktop utility that allowed us to view the address book and upload new entries”

MFPs. Although the initial outlay is high and wireless is optional, this is more than made up for with excellent print quality, affordable running costs and its high duty cycle. **DAVE MITCHELL**

SPECIFICATIONS

600dpi colour A4 laser • 1,200 x 1,200dpi colour flatbed A4 scanner • 35ppm mono/colour • 2 x USB 2 • Gigabit Ethernet • 33.6Kbits/sec fax/modem • 2 x RJ11 • duplex • 50-sheet ADF • 430 x 528 x 560mm (WDH) • 1yr on-site warranty
RUNNING COSTS High-yield: mono (8,000 pages), £99; CMY (6,000 pages), £129

LEFT Users can access Active Directory from the printer to directly search for colleagues' email addresses and fax numbers



ON SALE NOW



Order your print or digital MagBook
at **magbooks.com**



THE BUSINESS QUESTION

Could your business benefit from CRM?

Is customer relationship management only for the big boys? **Darien Graham-Smith** asks the experts what CRM has to offer, and how to get the best from it

In its simplest sense, CRM isn't a product. "Customer relationship management" might mean something as simple as making notes on a piece of paper. But investing in a centralised CRM system can help any business to better understand and serve its customer base.

"Companies of all sizes, in sectors as diverse as retail, healthcare, media, public services and manufacturing, rely on CRM systems," Steve Garnett, EMEA chairman of industry giant Salesforce, told *PC Pro*. "For small businesses, a CRM system may simply help put data in the cloud, making it accessible from any device. As a business grows, CRM can be quickly scaled up to include more sophisticated features that help teams collaborate with colleagues and

customers, send customised emails, gather insights from social media conversations, and get a holistic, real-time picture of business health." Daryn Mason, a senior director at Oracle, agrees. "All companies can benefit," he told us. "Today it's just as important to have a CRM as it is to have an ERP (enterprise resource planning) system, or back-office systems. It's an essential part of the infrastructure."

■ Measurable benefits

CRM may look like a questionable investment at first, because it doesn't directly generate revenue. "It's difficult to point to a specific number and say 'that's from CRM'," admitted Graham Anderson, managing director of OpenCRM, a British company

providing bespoke CRM services. "But better access to information makes your team more credible to customers, as well as better able to collaborate internally – we call it more 'joined-up'. That should lead to an uplift in both sales and retention." Garnett agrees: "The customer expects a great experience, and that can't be achieved without intimate knowledge of their likes, dislikes and preferences."

Mason notes that CRM systems can also improve a sales team's efficiency. "There's a direct correlation between 'face time' and success in closing business; CRM systems free up people to spend more time with customers.

I've worked in organisations where the sales guys use Friday afternoon to update their forecasts," he recalled. "A CRM service could build that forecast for them, and roll it up to their manager automatically."

"CRM is as important today as enterprise resource planning or back-office systems; it's an essential part of the infrastructure"

■ Calculating the costs

Free CRM software does exist, but in most cases it makes sense to pay for a service that's tailored to your needs.

"There are products out there that you can just take off the shelf, download and use," said Anderson, "and they have their place. But I think it's been proved time and time again that you still need some expertise and planning around these sorts of implementations. We build on open-source projects – such as MySQL, Apache and PHP – to keep the

licensing costs down, and we wrap that up in our own code, so that when customers need a particular function, we have a development team that works on it. That way, our clients get what they need, rather than choosing a product they have to shoehorn into their business."

In terms of architecture, modern CRM is normally a web- or app-based service, so minimal infrastructure investment is needed. "There are certain situations where 'install it yourself' still works," noted Anderson, "but more and more we're finding that even mid-range customers don't have the dedicated resources to run internal CRM systems. When you look at the costs of maintaining your own hardware, the hosted approach almost becomes a no-brainer."

"Another advantage of a cloud-based approach is that it's very scalable," said Mason. "With on-premises computing, you may start small, but then grow to a point where you need a more powerful box, or a faster network. With cloud CRM, you don't hit those sudden cost points. If you start with ten users and you grow to 100 users, it's linear: you never have that 'ouch' moment where you have to do a big upgrade."

Remember, however, that implementing CRM brings costs beyond the licensing fee. "Normally when people take on CRM they want to see big changes, and big transformations," Mason continued. "So there's a change-management process involved. It isn't only about technology; you're probably going to need to re-engineer some processes, and take people through change management and training."

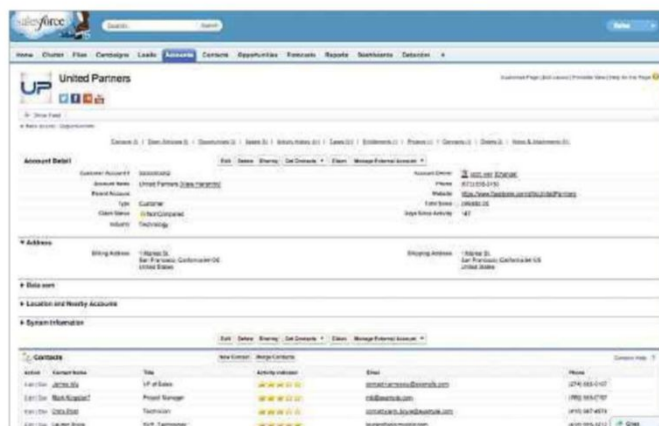
Thinking big

The industry experts agree that a simplistic approach can be the undoing of a CRM implementation plan. "You have to think about the project as a mix between technology management and people management," said Anderson. "Managers are often far too optimistic in their expectations about how users will accept change. It's something we strive to say, particularly in larger projects: if you don't include this amount of time in your plan for your personnel to prepare and adapt, then frankly you're on the cusp of 'sales prevention'."

"People like to think of technology as a magic pill," agreed Mason. "They think that if they get great technology, that's enough to transform their sales success, but it's never as simple as that. You absolutely have to understand the problem you're trying to solve, but it has to be seen in the context of people and processes. I see CRM as a stool with three legs – people, processes and technology – and your customer is sitting on top. If any one of those legs is wobbly, your customers are at risk."

Perhaps the fatal pitfall is underestimating the scale of the cultural shift involved in buying into a CRM platform, and the level of management buy-in that's needed accordingly.

"If CRM implementation is relegated to a departmental project or initiative, it often isn't given the prominence it needs," Mason warned.



ABOVE Tailor-made CRM systems are adapted to fit your business

"It needs to be seen as a strategic initiative for the whole business, and supported with sponsorship at board level. Otherwise, if you're trying to change business practices, and revitalise your customer relationships, the decisions you need to make can get stuck at the departmental level – they're seen as too hard, and are met with inertia and resistance. High-level sponsorship helps to drive through the changes and implement great CRM." ●



The expert view Jon Honeyball

There's a very wide set of tasks that come under the umbrella of customer relationship management,

depending on your market sector, size of business, number of customers and so forth. This leads to a dilemma: do you try to squeeze your perfectly formed, well-run business into whatever shape your chosen CRM system demands? Are you prepared to change your workflow, and your way of talking to customers, in order to bow down at the Temple of the Great CRM? Or, do you try to get something written or customised to fit your business, in the hope that it will help you to do what you do already without getting in the way?

For many businesses, the reality falls between the two: you end up with some significant changes to the way you work, along with some reinforcement of how you do things already.

Is this the optimal approach? Well, here we get to the crux of the matter. If you implement a new CRM (be it local, cloud-based or scribbled on the back of a well-worn envelope), how are you going to measure its effectiveness? How do you measure the quality of your customer relationship today? Do you wait for someone to shout, or for a writ to land in the post? Or do you have regular conversations with your customers to discuss what you're doing well, what you need to improve, and indeed what the client needs to do in order to work more effectively with you?

When it comes to CRM, it's important to map your solution onto those issues. But far too often I have seen CRM simply bolted on to a workflow, with no attempt to work out what customers are really experiencing. The results are usually dire, in some cases resulting in the failure of the company. I wouldn't suggest that such businesses had been

rock-solid before, of course, but I'm certain that some companies' CRM implementations have accelerated their decline.

So my recommendation is to tread carefully. Try to talk to others in your market segment, if that's possible and appropriate, and find out from them what works well and what doesn't. In digesting their experiences, consider how similar their operations are to yours, and what differences between your circumstances you need to take into account. Ask yourself exactly what problem you're actually trying to solve – and when you've decided on a CRM solution, ask yourself whether you've truly analysed the cost of implementation, in terms of time, training, disruption and overall risk to your business.

Moving to a new CRM platform is a huge project, and if you can't answer these questions with total confidence, you're not ready to undertake it.

Security as a Service

Davey Winder explains how modern security is much more than simply installing antivirus software on your workstations



■ Security as a Service – what’s that then?

Security as a Service (SaaS) is a licensing model whereby your security product is purchased on a subscription basis, and delivered through a centrally hosted mechanism. Think of it as a cloud-based outsourcing model for security management and you won’t be far wrong. Or, if you prefer, you can go all Tolkien and describe it as “one solution to serve them all” – meaning the same back-end watches over all of your various endpoints, from desktops to servers to mobile devices. The services on offer range from traditional desktop security scanning to fully managed email hosting and website-vulnerability scanning.

■ But isn’t the cloud the Wild West of the IT world? Should we trust our security to it?

Like it or not, the cloud is now accepted as part of the business IT furniture, from the smallest to the biggest of companies. The same is true in the consumer space: we’ve all become used to interacting with cloud services for data storage, email and service delivery such as music and video streaming. As the cloud has become more familiar, it’s matured, to the point where it can be generally trusted to deliver security solutions. Remember, we’re not talking about the security of the cloud itself, merely its suitability as a distribution channel for the services that do the actual work of protecting our data and resources.

■ So what’s really new and different about SaaS?

Traditionally, the security industry has tended to develop in evolutionary steps – even in response to major developments in the threat landscape, from the emergence of distributed denial-of-service (DDoS) through to the rise of targeted, long-term attacks known as “advanced persistent threats”. With the speed of delivery offered by the cloud, there’s a real feel of revolutionary change in our defences at last. By its very nature, the security-services industry will always be largely reactive – attackers launch a new threat, and then security services respond to it – but cloud delivery means the response can be launched more effectively than ever.

■ Isn’t this just a case of following the herd?

It may look like security providers are simply jumping onto the fashionable cloud bandwagon, but there’s more to it than that. The major threat no longer comes from virus infections that can be countered by signature-based standalone products; threats are now mobile and dynamic, so the defences need to be the same. By moving to a model where both users and threats are diversely distributed, the vendors can do a better job of protecting the former from the latter.

■ So where does this leave traditional, perimeter security measures?

If traditional measures aren’t dead in the water, they’re much less relevant than they used to be. The average business nowadays has data sitting across a number of networks and devices – plus users bringing in their own devices and using their own cloud services – so traditional network security becomes difficult to enforce. Moving security into the cloud makes it easier to apply to all devices and all traffic.

■ So SaaS is more than just a cloud-based antivirus scanner?

You seem to be getting the idea! SaaS is much more flexible than conventional antivirus, so it can fit the needs of both businesses and consumers. Think of it a pick-and-mix approach, offering the precise protection to meet your needs. For example, as well as protecting against the latest malware threats by ensuring your security database is always up to date, SaaS can simultaneously provide DDoS protection that kicks in with the necessary measures as soon as a potential attack is identified.

“The major threat no longer comes from virus infections that can be countered by signature-based products”

■ This is starting to sound expensive...

The subscription fees actually compare quite favourably to managing your security locally – once you factor in the regular product upgrades and the management of those updates, which you no longer need to worry about.

Being able to budget on a per-user basis, with management of real-time updates, can dilute both the cost and complexity of keeping your business secure. It’s easier to deploy additional services, too: DDoS protection, for example, can be provided by way of a budgetable monthly supplement, without the need to roll out new hardware or think about update costs as the threat evolves. ●

The jargon

SaaS Originally “Software as a Service”, now often stands for “Security as a Service”. Generally speaking, a software service that’s delivered via a central host and paid for on a subscription basis.

DDoS Distributed denial-of-service: an attack whereby online business resources are taken offline by overwhelming them with “junk” traffic from multiple sources.

Perimeter security Network defences provided via firewalls and intrusion-detection systems – a well-established model, but one that doesn’t necessarily suit the modern Bring Your Own Device (BYOD) approach.

Threatscape The overall security threat environment, comprising both attack methodologies and attacker profiles.

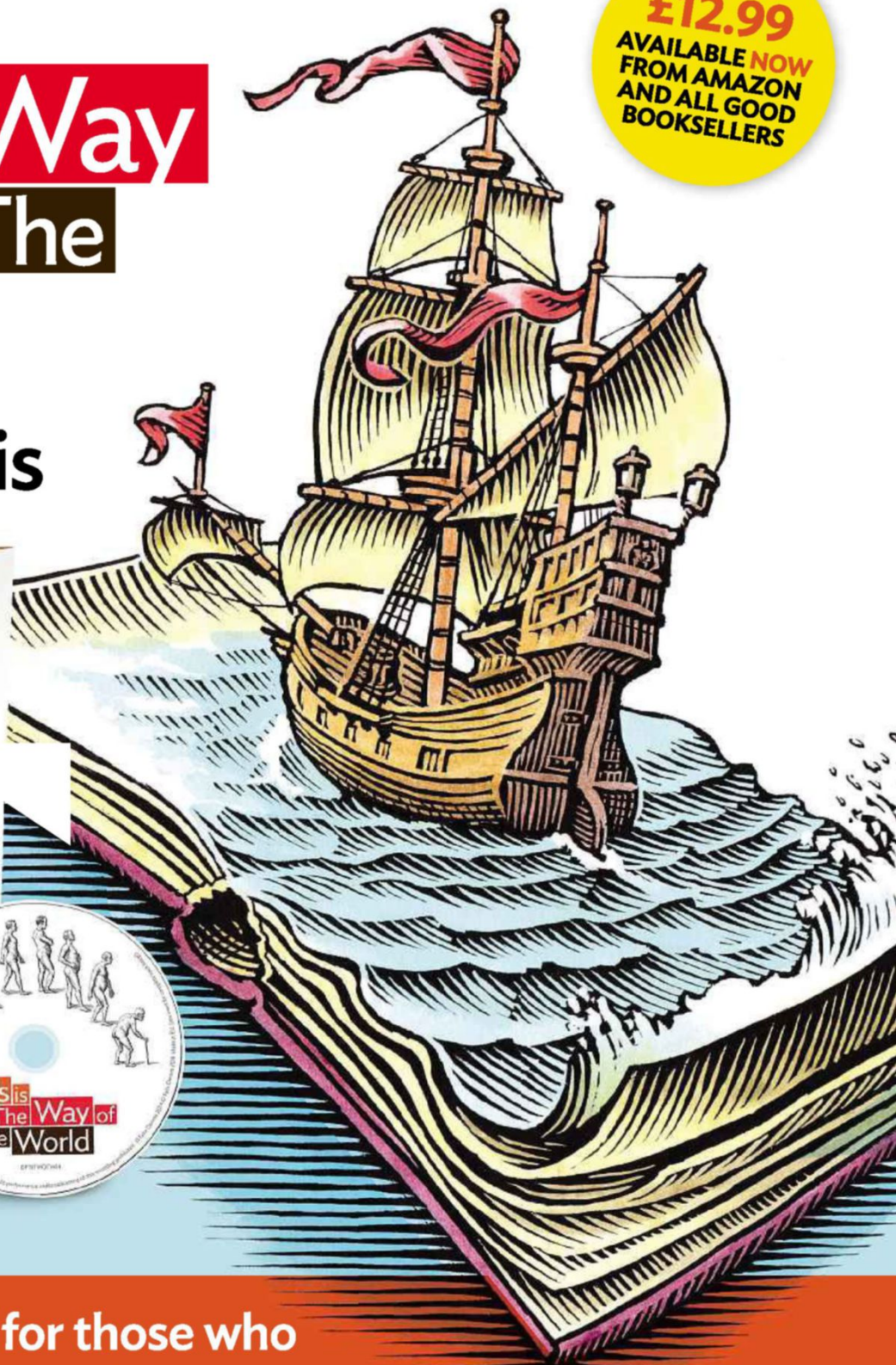
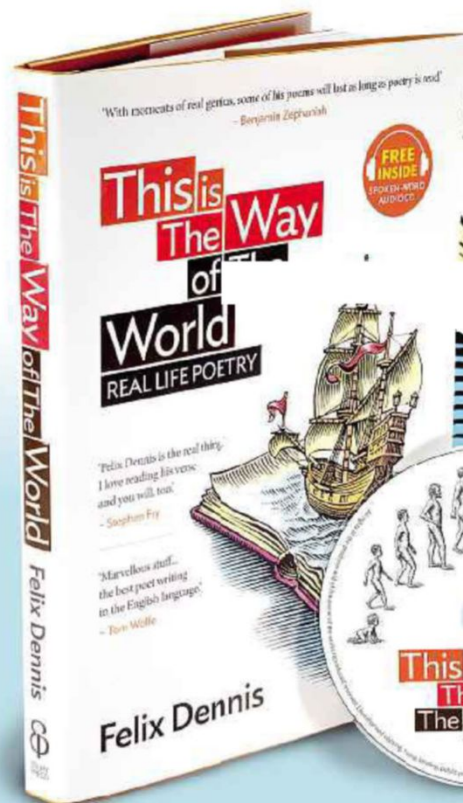
'With moments of real genius, some of his poems will last as long as poetry is read.'

– Benjamin Zephaniah

This is The Way of The World

Felix Dennis

RRP
£12.99
AVAILABLE NOW
FROM AMAZON
AND ALL GOOD
BOOKSELLERS



**A book of poems for those who
don't read poetry** (as well as for those who do!)

A collection of 'real life' poems by Felix Dennis, one of Britain's best-loved poets, charting life's course from infant to endings with illustrations by Bill Sanderson.

www.felixdennis.com contains many poems, published and unpublished, as well as a library of sound recordings and video footage of Felix Dennis's verse and poetry tours.

JON HONEYBALL

“These companies are shining examples of the way Europe is still creating some of the best technology in the world”

Jon is impressed by some Buckingham-produced GPS equipment, which provides record-and-replay capabilities at a reasonable price

Last month I was talking about some of the technical innovations coming from the company Meridian, in Huntingdon, in the field of studio-quality encoding of music over a limited-data-rate pipe. This month I've decided to extend this theme by covering some more interesting technology from a pair of companies – one in the UK and one in the Netherlands – who are shining examples of the way we in Europe are still creating some of the very best technology in the world. The American hegemony in electronic innovation was an historical accident that's becoming less relevant: indeed, it's the lack of true global vision that will be the downfall of the big American companies.

Let's begin with GPS. There's a set of orbiting satellites that transmit the GPS signal: essentially a very accurate time clock that's synchronised between these satellites. If you can receive this signal from a number of the satellites, and because you know where they are and the time delays between their transmissions, you can triangulate your position in 3D space, relative to the satellites' orbits. That's right, 3D: it's easy to forget that GPS

provides height information, because most of us are locked into a mindset of strictly 2D, in-car GPS from the likes of TomTom and Garmin.

However, give it some thought and you'll soon discover that information about absolute 3D positioning is terribly important if you're, say, the captain of a Boeing 747. (Incidentally, there's a world of pain concerning the way 2D maps can be projected onto the roughly spherical surface of our planet, and how the inevitable distortions each different projection produces are to be compensated for – but I'll leave reading up on that to you, if you're sufficiently interested.)

So your current position is defined not only by where the satellites are, and which members of the global set they are, but also by the time at which you're taking the measurement – move the time by ten minutes and the satellites will have moved, as they aren't in geosynchronous orbit.

If you wanted to subject a GPS unit to exactly the same conditions – and I'm willing to confess this isn't something that will interest most people, but bear with me – it would be incredibly useful to be able to record these actual GPS signals (say, while



Jon is the MD of an IT consultancy that specialises in testing and deploying hardware
@jonhoneyball

“The American hegemony in electronic innovation was a historical accident that's becoming less relevant”

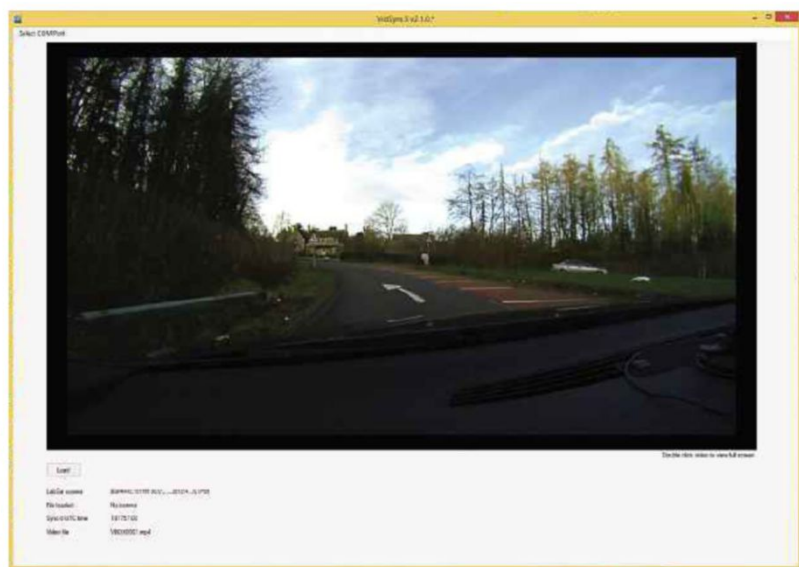
going for a drive) and to then play them back at a later date. As far as the GPS unit was concerned, such playback would be as if it were travelling that exact same route again, at that date, and nothing would ever change, run after run.

GPS record-and-replay equipment has been around for a while, but it's been prohibitively expensive, affordable only by the military, space agencies and similar. Now, Racelogic – a small but highly respected UK GPS engineering firm based in Buckingham – has changed all that, because its new LabSat 3 box can record real GPS and then play it back, at a reasonable cost.

Before we go any further, I need to explain something important. When you replay recorded GPS signals, you're creating an entirely time- and location-shifted space. So while it might strike you as being hugely amusing to sit in a traffic jam on the M1 while transmitting a signal that tells everyone around you that you're all actually in Devon last Tuesday, it would also be highly illegal. And very dangerous too.

I flew into Incheon Airport in Seoul, South Korea, last year, a few days after North Korea had been making noises about disrupting the GPS signals – not what you want to hear just as your 747 is coming in to land. Handling signals of this kind clearly requires great care: you must operate it within a radio-screened environment (commonly called a Faraday cage) and measure the signal levels to ensure that there's no leakage whatsoever. That's a legal requirement, and if you do otherwise men in suits will arrive, knock on your door and cart you off to jail.

Racelogic's software is stunning. Record a GPS scenario while driving around in your car, and replay it into a GPS device when you're back in the warmth of your lab (you do have a lab, don't you?). Then do exactly the same again tomorrow, to provide an entirely repeatable test environment.



LEFT Racelogic's LabSat 3 box can playback recorded GPS signals



Jon Honeyball
Opinion on Windows, Apple and everything in between – **p110**



Paul Ockenden
Unique insight into mobile and wireless tech – **p113**



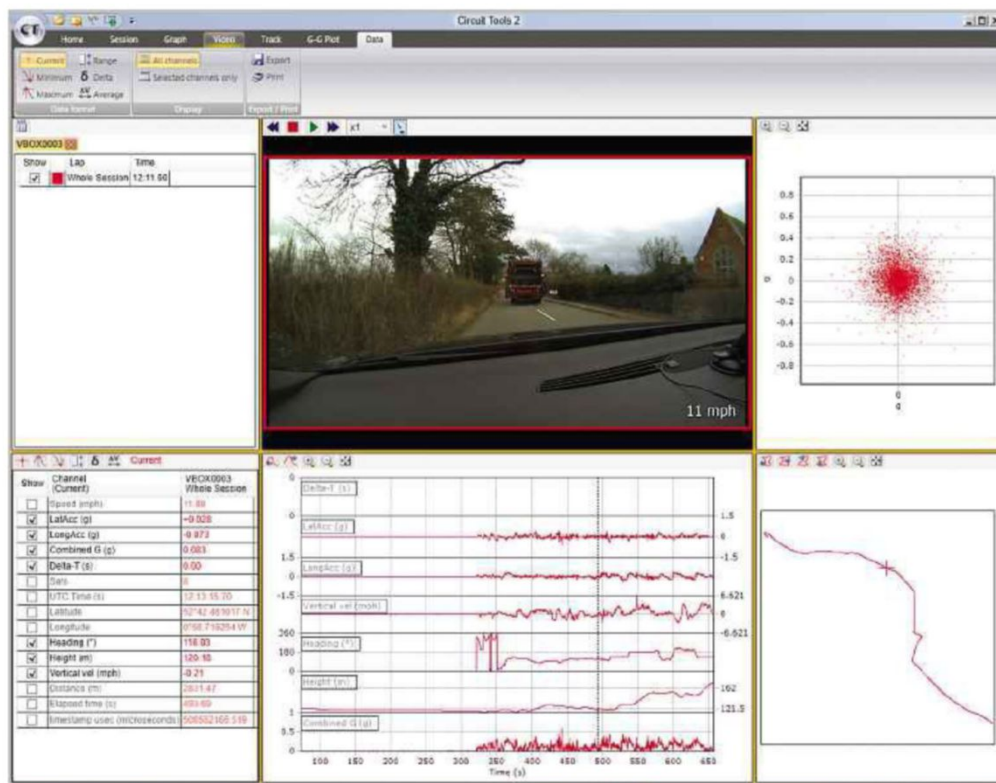
Nick Dale
How open-source tools built real-world prototypes – **p116**



Davey Winder
Keeping small businesses safe since 1997 – **p118**



Steve Cassidy
The wider vision on cloud and infrastructure – **p120**



But that's not all – this software can import the simple recorded route information that any normal civilian GPS unit logs during a journey, then recreate the original GPS satellite signals that must have produced that information, so they can be played out again. This is a massively difficult computational geometry problem, and you can expect it to take up to ten times longer than real-time, so to regenerate the signals for a one-hour journey might take eight hours of processing time.

Or how about firing up Google Maps and just drawing in a route that you want to take, or synthesising a route entirely from numbers? In each case, Racelogic's software can then generate the appropriate GPS signals for you. Want to make a GPS unit think it's in the middle of Madrid on a Thursday afternoon, without leaving your desk? No problem.

The company has also designed a unit for video recording, called the Vbox, which takes the output from an HD-resolution bullet camera and a live GPS feed from a mag-mount GPS aerial, and records video of what the camera sees through your windscreen; along with all the

synchronous GPS data too. When you play back this video on your Windows PC, it not only plays back the video but it can also calculate a whole range of data (see screenshot above) such as the acceleration, direction of travel, vertical height and so forth, which you can just read out as the video plays. You can see why that would be incredibly useful for car-development work or analysing race performance.

The power really starts once you connect the LabSat box to the PC running the playback of the Vbox video file. Now you can generate the "real" GPS signals to feed into a GPS device and receive a correctly synchronised view of exactly where the device was located at that point in time on the video feed. This makes it easy to see whether, for example, the GPS unit you're testing is suffering from lag when going around a roundabout (due to having to reacquire its signals repeatedly).

This is all powerful stuff, which would have been almost unthinkable even only a few years ago. It clearly shows the strength of the engineering base we have within the UK, and is therefore to be loudly applauded.

DAB hands

Now let's move on to a different transmission technology, namely Digital Audio Broadcasting (DAB). DAB is an antiquated, superseded and, frankly, rather insulting piece

of technology. However, it has entranced various government departments for decades, so we're stuck with it, despite it being the wrong solution to the wrong problem at the wrong time.

The rest of Europe has moved on to DAB+, but we're stuck with the original. The core function of DAB is to take a low data rate – and hence low-quality – audio feed, crunch it down to the size of a postage stamp and then broadcast it over a digital carrier in around the 200MHz frequency range. As you can imagine, there's quite a small market for DAB generation and transmission hardware, since all the big broadcasters already have real-time solutions in place that once did cost vast sums of money, but which they've been able to amortise over several decades. The rest of us, who might someday need to generate a desktop DAB signal for test purposes, have to scabble around with what's available.

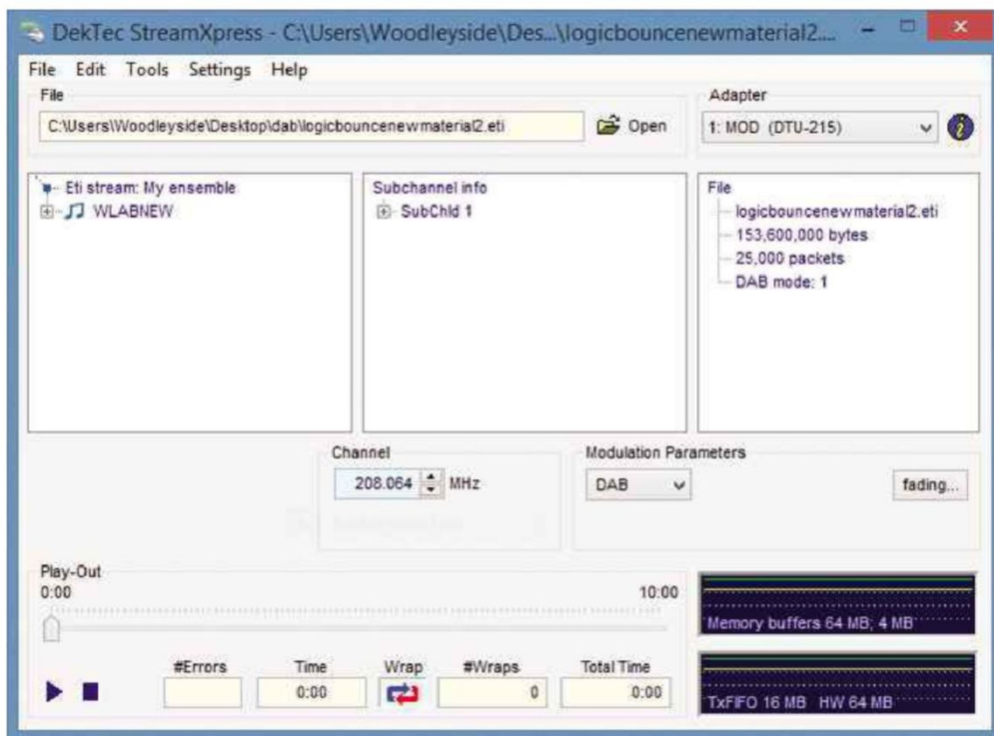
Or maybe not. DekTec, from the Netherlands, has come up with a range of affordable, high-performance PCI Express cards, alongside hardware based on the USB bus, which can transmit DAB, DAB+, DVB-T (digital terrestrial TV) and so on.

Let's just walk through the process of making this work. We'll start with the audio file you want to work with, which should be WAV format at 48kHz sampling rate (that is, a sound quality akin to CD). But the data rate for such quality is far too high for DAB transmission, so we need to reduce it. You may think this is simply a matter of choosing a different output from your audio-editing software, but this won't happen for two reasons: first, DAB doesn't use MP3 format, but rather MP2, its predecessor; and second, it isn't even normal MP2, which would have made things too simple. There are special data flags that have to be placed into the MP2 stream to support DAB.

But that's not all – next you have to think about the data rate that you'll be using over DAB. The best quality employed in the UK is for BBC Radio 3, which transmits at 192Kbits/sec, but most other stations are more compressed at 128Kbits/sec, while speech is right down at 64Kbits/sec. Just think that through. Take some content that was once akin to CD or FM at its best, encode it using an ancient codec at a ridiculously low data rate: does anyone really want to

ABOVE Playing back video enables you to calculate plenty of other data, allowing you to analyse race performance, for example

"DAB is an antiquated, superseded and, frankly, rather insulting piece of technology"



listen to 128Kbits/sec MP2? Does anyone really think this is quality?

The best tool for performing this feat of aural desecration is an open-source one called TooLAME, and the command line you'd use to take in a nice 48kHz WAV file and output a grotty MP2 is:

```
C:\toolame -s 48 -ms -b 192 -e -D 0
logicbouncenewmaterial2.wav
logicbouncenewmaterial2.mp2
```

You now have an MP2 file you can work on. Next you have to turn this into an ETI file, which stands for Ensemble Transport Interface. Without getting bogged down in complex details, DAB employs a transmission format called OFDM, or orthogonal frequency-division multiplexing. OFDM is also used for the likes of 802.11n and 802.11ac Wi-Fi and even for terrestrial digital TV in the DVB format. ETI streams are effectively the bundled data that allow the transmitter to output them in OFDM format. You have to remember that DAB isn't just one station transmitting on one frequency: unlike FM radio, you can bundle together several DAB "radio stations" onto a single channel and transmit them all at the same time on

the same frequency, which is all part of the idea called an "ensemble". To convert your newly minted MP2 file into an ETI file, you need to use a tool called DabMux, which is driven by a command line that looks like this:

```
C:\program files (X86)\dektec\
StreamXpress\dabmux -f 25000 -o logic
bouncenew *material2.eti wlabmp2.xml
```

This tells DabMux to generate 25,000 frames of data (a data frame being about 2,500 per minute) and output the ETI file, but also to suck in a configuration file in XML format. Here's the XML file I used:

```
<ensemble transmode='1' id='0x123'
country='15' ecc='0xE1' label='My
ensemble'>
<service id='3' country='15'
label='WLABNEW'>
<component primary='true' ca='false'
prot='UEP-3' bitrate='192' filename='logic
bouncenewmaterial2.mp2'>
<mp2/>
</component>
</service>
</ensemble>
```

As you can see, there's some technical stuff in the first part, including a country code, and the name I'm going to use for my ensemble. Then we go to the service part; the "WLABNEW" is the name of my radio station. This is what you'll tune into on a DAB radio set. Then there's the component itself: it references the MP2 file just

ABOVE With DabMux from DekTec you can convert your MP2 file into an ETI file

"With professional tools, there's a responsibility for providing a level of support that goes beyond call-centre staff asking: 'have you tried turning it off and on again?'"

created and specifies the data rate to be 192Kbits/sec. There's an MP2 section to this XML file, but this isn't used. Now having this ETI file, I can fire up the DekTec software, load in the file, choose a broadcast frequency, and press Play. At this point, my new radio station will be broadcast out of the aerial socket of the DekTec unit, and I could attach a small aerial to it for reception by nearby DAB radios. Tune in the radio set and our new radio station is on air. Once again, just as with those GPS transmissions, you must do this inside a shielded Faraday cage environment to ensure that there's no possibility of leakage over even a few metres.

Less than friendly

So what do these two hi-tech solutions have in common? Well, first, both would have been impossible only a few years ago. The power of modern PCs means that such specialist hardware can now be connected via USB and used to perform high-end work. General-purpose programming languages enable developers to write software solutions that can drive such hardware, and the prices are now affordable – in the context of professional lab equipment. Neither of these solutions is appropriate for a bedroom hobbyist, from a cost, complexity or broadcast responsibility perspective.

They're also similar in terms of the sheer complexity of their exposed capabilities. These aren't solutions that you can just fire up, fiddle with and press Go. Both require detailed knowledge and an understanding of what's going on; there's nothing wrong with that, of course, since they're professional tools. However, both also have UIs that are, shall we say, "curiously cranky", and they provide a clear and fascinating reminder of just how far we've travelled in the business of delivering software to mainstream audiences. These tools are generally written by the engineers themselves, so poor error-handling and crashes when you ask them to do anything odd aren't unusual. They can be frustrating to work with.

At this point, you're probably expecting me to turn my flamethrower of hate onto both firms for delivering fragile and cranky software, but I'm not going to do that, and here's why. These are bleeding-edge technologies and solutions; professional tools for professionals. And with that comes responsibility

for providing a level of support that goes beyond call-centre staff asking: “have you tried turning it off and on again?”. Both companies have excelled in this regard.

I uncovered a Windows 8.1 USB port bug in the Racelogic code, and the developer sent me a new version on Boxing Day, then several more versions over the subsequent days. I was doing battle with the DekTec DabMux software, PDF instructions for which were inducing a headache: it looked like English, it sounded like English, but I had no idea what it was saying. DekTec’s developers worked tirelessly to explain what to do, how to make it work, and sent over scripts and example files. Both companies actively seek suggestions on how to improve their products, but being such niche products they probably won’t receive many. I’m more than happy to help (after all, I’ve invested a five-figure sum in their technologies) simply because I believe both are serious about what they’re doing and clearly want to smooth out the few remaining rough edges.

Contrast this with a company that sells an expensive Thunderbolt-connected 4K video encode/decode box I bought last spring. I’ll be polite and simply say the claims made by the company around the capabilities of its product didn’t match my experience. Only when I went nuclear over the phone at the product manager did he admit that some of those claims were a tad optimistic. I won’t be doing business with the company ever again, because I don’t need hassle like that.

Racelogic, on the other hand, even delivered some of its kit of parts in person, because it wanted to know what we were intending to do with it. This sort of support is the lifeblood of serious engineering companies, and is a clear differentiator between the good and the ugly.

I hope this insight into some slightly unusual technology has been useful. It’s a clear reminder that our desktop computing world – whether that be Windows, OS X or Linux – has a far broader reach than the million-selling but mundane Office applications – and that there’s still world-leading work being done on our doorsteps.

jon@jonhoneyball.com

PAUL OCKENDEN

“After a few seconds, you completely forget that you’re staring into a phone strapped to a cereal box”

Virtual reality may finally be hitting the mainstream – for less than £3, you can even turn your phone into a headset

Virtual reality (VR) is one of those strange areas of tech that’s been knocking around for ages, perpetually about to explode into the mainstream but never quite managing to achieve it. The idea can be traced back to science fiction from the 1930s, while the first crude and clumsy devices appeared in the 1960s. One of these first VR incarnations, created by the influential computer scientist Ivan Sutherland, dangled above the user’s head in such a precarious fashion that it was nicknamed the “Sword of Damocles” (see more about Ivan Sutherland in our feature on tech heroes, p42).

At various times since then, mass-market adoption has seemed just around the corner but never actually happened. It was almost 25 years ago that Sega promised the Sega VR headset for its popular Mega Drive console. There was much hype, but it never arrived: the project proved too difficult for mass-market production and was shelved, although a version did appear in arcades a couple of years later. In the mid-1990s, Nintendo tried for the same market with its Virtual Boy, an innovative headset-based games console. Unfortunately, that was such a commercial flop that



Paul owns an agency that helps businesses exploit the web, from sales to marketing and everything in between
@PaulOckenden

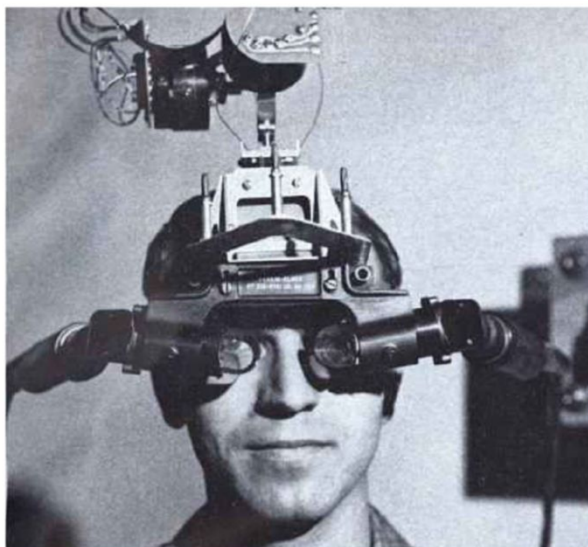
it never even reached Europe, and the whole project was cancelled within a year. (Even its product name would be considered a bit dodgy these days!)

I ought to clarify something at this point, because the term “virtual reality” bears two meanings, one broad and one narrow. The term can encompass anything that simulates a real environment, and so may include those walk-in flight simulators on stilts that pilots use for training, and their smaller cousins that you might find in theme parks. The second, far more specific meaning of virtual reality (especially when abbreviated to VR) is restricted to those headsets you strap over your eyes (and often ears) that give a stereoscopic view of an artificially generated world, the display of which is updated as you move around this environment. I’m talking here about this restricted sense of VR, and it’s such VR headsets that over the past year have seemed about to go mainstream.

The best known is the Oculus Rift, which despite all the hype hasn’t actually shipped yet. The kit you may have read about or seen on TV gadget programmes, perhaps even played with at a demo or show, is all pre-release developer and SDK hardware. These developer headsets provide vision only, so the user has to supply headphones. They’re also quite heavy, at around 379g, roughly the same as a can of Coke. Just try to imagine walking around with a can strapped to your face by a thick elastic band. Padding inside the headset helps, but it’s still not the most comfortable of experiences. I hope when the consumer version arrives – promised later this year – it will be both lighter and wireless. All the versions to date have required an umbilical cord tethering them to a controller box, which uploads stereoscopic visuals to the headset and downloads six-axis motion-detection data to the host computer.

You may wonder why six axes of data have to be recorded, since many

BELOW Ivan Sutherland’s “Sword of Damocles” was one of the first VR headsets



motion-tracking systems monitor only the X, Y and Z axes. However, a six-axis system (one with six degrees of freedom, or 6DoF) can monitor not only the estimated position in 3-space using accelerometers, but also *rotation* in any plane using gyroscopes. This is important for headset-based VR, as the display needs to scroll when you rotate your head. It's quite different from an Xbox Kinect camera monitoring your movements, with the display staying in a fixed position (although there are libraries available to extract estimated head-pose data from Kinect sensors).

I mentioned "gyroscopes", but don't imagine them as those spinning discs in use a decade or two ago: modern gyroscopic sensors are tiny solid-state chips with lithographically constructed components. Various kinds are available, but perhaps the easiest to understand is the "tuning fork", which has two moving arms continually oscillating in opposite directions. When a twisting motion is applied, the Coriolis force on each arm acts in opposite directions, changing the capacitance between them proportionally to the angular velocity of twist. It's mind-boggling to imagine this going on inside minute sensors inside each Oculus Rift (as well as many other everyday objects, such as optically stabilised camera lenses). These movement and positional sensors distinguish true VR headsets from first-person view (FPV) kit such as Fat Shark goggles – normally used for remote piloting of radio-controlled aircraft and drones – or home-cinema goggles (yet another technology that never really took off). Both these headsets are for display only and don't need to record head tilt or position.

Interestingly, Oculus Rift started life as a Kickstarter project with a

\$250,000 goal, but ended up raising ten times that and subsequently being bought by Facebook for \$2 billion. All of this happened long before the final product had shipped, which caused something of a backlash: many of the original backers demanded the return of their crowdfunding cash, as they weren't happy their investment in a niche product had ended up in the hands of an "evil empire".

Despite these complaints, the success of the crowdfunding venture meant many other rival VR systems soon started to appear on Kickstarter, Indiegogo and other funding sites. Some of them are obviously just flying a kite, and these are pretty easy to spot for making outlandish claims and/or merely using images of readily available hardware. Here's a tip: before investing in any crowdfunded project, always do a reverse search on the images shown in their listing. If you find them being used anywhere else – especially on one of the large Chinese marketing websites such as Alibaba or Banggood – then this project might not be what it seems...

A few of these projects do seem credible, though. One called Totem, from Vrvana (pronounced ver-vana, and yes, it sounds like something from *Shooting Stars*), looks particularly interesting: it has two front-facing cameras in addition to the individual display screens for each eye. This enables it to mix a VR feed with images from the real world, like a halfway house between a full-on VR unit and an augmented-reality headset, such as Epson's wonderful Moverio BT-200.

Beyond these start-ups and crowdfunded projects, there are a few big-name players entering the VR arena. Sony has Project Morpheus, a five-year (and counting) R&D project, which is being continually

updated. It should be ready to launch quickly whenever Sony feels market conditions are right. Certainly the demo versions Sony takes to various trade shows have a fairly finished feel to them, with nice, smoothly moulded plastics and a really solid build. This is no temporary, 3D-printed demo kit.

I'm in the phone...

There's a whole other angle to this market sector, too. Think for a moment about the components you need for a VR headset: a high-resolution display, accelerometers, gyroscopes, connectivity to the outside world, and CPU grunt to tie them all together. As a list of parts, does that sound vaguely familiar? You probably have all of it in your pocket right now. Yes, the main guts of a VR headset can already be found inside any smartphone, and a few vendors have already cottoned on to this fact.

For a start, there's Samsung with its Gear VR (see our full review on p74). Essentially this is an Oculus Rift-style housing, into the front of which you slip a Note 4 "phablet" (I'll never stop being embarrassed to type that word, hence the quotes). Strangely, this headset contains its own movement sensors rather than using those built into the phone. The Gear VR is not only confined to Samsung's Note 4 model, but the current development version is even further restricted to work only with handsets locked to certain US carrier networks. No, don't ask me why – it seems crazy to me.

If you want a wider choice of phones, look no further than the Carl Zeiss VR One. The big selling point is that it contains "quality" Zeiss lenses, although I suspect for many the Zeiss brand has been tarnished by licensing the name to glass made by companies such as Sony and Microsoft/Nokia. The VR One not only supports a number of different handsets, but also exploits their internal gyroscopes and accelerometers. You need a special tray to hold your phone, but Zeiss is planning to release these for popular handsets, and to offer 3D-printing plans for more obscure phones.

Cheaper still, and even more flexible, are the Archos VR Glasses, a simple, black plastic affair designed to work with most smartphones with a 6in screen or smaller. It's a no-frills affair, but what do you expect for £25? Surely you won't find a VR headset any cheaper than that.

Or will you? Actually, the answer is yes! By far the cheapest option is the Google Cardboard, and you can

"You probably have all of the components needed for a VR headset in your pocket right now"



LEFT The Oculus Rift is probably the best-known virtual-reality headset



LEFT The Carl Zeiss VR One is a low-cost headset that should work with most phones

probably guess what it's made from – the clue is in the name. It's essentially a folded piece of cardboard with two plastic lenses, a couple of magnets and some Velcro. The brilliant thing about it is the price: you can pick one up for less than £3 (for example, from pcpro.link/246rw1). You can even cut one out yourself using a template, but I can't really see the point when the kits are so cheap. It's been somewhat cheekily nicknamed Oculus Thrift!

So, what can you do with Google Cardboard? Well, Google has a Demo app that provides a number of simple things such as 3D Google Earth views, 3D YouTube videos, and a natty VR tour of Versailles. You'll soon get bored with those, but head on over to pcpro.link/246rw2, or go to the Play store on your phone and search for Cardboard. You'll find plenty of Cardboard-enabled apps there that let you ride a VR roller coaster or watch a 3D Paul McCartney gig (to be honest, I'm not sure which is scarier).

There's much more to try, too. My favourites include Vanguard V, a third-person rail shooter game that delivers an immersive experience – after a few seconds, you completely forget that you're staring into a phone strapped to a cereal box. Sisters from Otherworld Interactive is a haunted-house story, and it's really very scary!

Most of these apps are free, but if you don't mind spending a small amount, I highly recommend Proton Pulse. If I tell you it's a 3D version of the old brick-busting Breakout game you'll probably roll your eyes, but it's far better than it sounds.

Incidentally, although Cardboard has its greatest support on Android, you can also use it with iPhones. Search for Google Cardboard in the App Store and you'll find some great apps, including the inevitable virtual roller coaster, along with a quaint duck-shooting game (quaint in the way it works, not in the way you kill virtual animals!).

Before you do, though, may I suggest you mark those panels and edges of the Google Cardboard that touch your face or hair, then unfold it and cover those edges with parcel

tape or similar fabric. If you don't, you'll find the cardboard sucks grease from your face (especially if you pass it around among friends) and starts to resemble a used pizza box. It seems daft to go to all that trouble to protect something so cheap, but it's worth it.

I wanted to find out what a professional VR developer thought of Google Cardboard so I spoke to Iestyn Lloyd, one of the UK's leading VR developers, who has created games and apps for Oculus Rift and other high-end hardware. He told me: "It's great as a platform to keep kids entertained. Not only are the headsets very cheap, but they can be drawn on or otherwise customised. If you want more robust versions, some vendors are supplying them in aluminium."

Iestyn and I got chatting about possible applications for VR, particularly for low-end kit such as Cardboard. He explained how "for installations and expos, it's much cheaper to demo VR using Google Cardboard rather than expensive PCs running Oculus or other high-end headsets. Supervision is still important, though, because the headsets contain mobile phones, and you don't want those to go walkies. Google Cardboard also offers a great marketing opportunity: you can give away customised headsets (printed with your branding and logos) at events, including a QR code or NFC tag for the visitors to download and install your company's VR app. You can then use push notifications to keep these people engaged over a longer time frame. For people such as myself who build VR games and apps for a living, we can use Cardboard to deliver cut-down or 'lite' versions of 'full' VR experiences, for a preview."

"Frankly, the possibilities for virtual reality are endless, and I'm very excited to be working in a field such as this right now"

I also asked whether he could see any instances where low-end VR headsets had an advantage over higher-end kit. He explained: "It's important to realise app-based content produced for any of these low-end, phone-based headsets can be repurposed or built into a normal non-VR app. Imagine, for example, an app that showcases a stunning new office development. It would work as a perfectly normal app, but when viewing photos the user could pop their phone into a Google Cardboard headset and take a look around for the full-on VR experience. Frankly, the possibilities are endless, and I'm very excited to be working in a field such as this right now."

I can't help but agree. We've seen so many false starts for VR, but with all these players currently developing both hardware and content, it will almost certainly break through to the mainstream this time. Right now, hardware and software remain fairly crude, but I'm sure we'll quickly move beyond headsets. I'm not sure we'll reach the point once envisaged by Ivan Sutherland, inventor of that original Sword of Damocles, when back in his 1965 paper *The Ultimate Display* he wrote: "The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal." Now that's a scary game opportunity (and a strong incentive to pay your phone bill on time!).

BELOW Google Cardboard can convert your smartphone into a VR headset for only £3

@PaulOckenden



NICK DALE

“Today it’s feasible for small teams of motivated engineers to tackle previously ‘impossible’ problems”

A background in aerodynamics and open-source software proves enough to create a prototype car – with a little help from some friends

From time to time, we all find ourselves looking out of the window and daydreaming. Among the fast cars, holidays and lottery wins, there may be the occasional “Wouldn’t it be great if...”, quickly followed by, at least in my case, “How hard can it be?”

This is one such story. It’s a tale of ambition, teamwork and talent (mostly other people’s). And it’s also the story of how modern PCs and largely open-source tools can solve problems that a generation ago weren’t only difficult but, by all practical measures, impossible.

By personality and training, I’m an engineer. Many years ago, when BBC Micros were cutting-edge, a fascination with aircraft led me to study aerodynamics. On qualifying, my career quickly took me in other directions, but the fascination with all things aeronautic remained.

Two years ago, my brother, Jeremy Dale, asked if I knew anything about car aerodynamics. He and a business partner were building an ambitious tandem-seat hybrid car. While he could take on the complicated electronic tasks, he had no understanding of aerodynamics. They needed a body shell that wouldn’t compromise performance.

Since I spend some of my spare time using the open-source surface-modelling package Blender, I had the means to draft such a shape. Google would surely provide the technical guidance on vehicle drag. “How hard could it be?”

Several things quickly became apparent. To do this properly would require multiple computational fluid mechanics (CFD) iterations, followed by validation in a wind tunnel. CFD tools typically cost thousands per licence and run on computers that



Nick initially worked as an aerodynamicist before moving into systems engineering. He’s currently an engineering manager

could heat a small town. All of which were beyond our means.

Searching for a solution, I came across an open-source CFD toolset called OpenFOAM, which stands for open-source field operation and manipulation. It has the capacity to model a huge range of fluid-mechanics problems. The toolset comprises solvers for the equations of motion, turbulence models, mesh generators and analysis tools. Everything you could possibly want, apart from knowledge and understanding.

So begins the journey

OpenFOAM runs only on Linux, so the first of many learning opportunities involved setting up a VirtualBox Ubuntu VM on my trusty Acer laptop (Intel Core 2 Duo processor, 4GB of RAM). To my surprise, with the settings more or less a stab in the dark, OpenFOAM ran successfully – albeit slowly. Clearly having good tools doesn’t alter the fact that fluid mechanics calculations are computationally expensive. We quickly replaced my laptop with a Core i7-equipped Dell PC. It was easily the fastest computer I’d ever played with, earning the name Monster.

Porting the laptop’s setup to Monster convinced us we might be

able to do something useful with off-the-shelf hardware, particularly when we started to run OpenFOAM in parallel across eight threads. Everything subsequently represented refinement, streamlining or supercharging of this setup.

With Monster up and running, we had a tool that could provide an insight into what was happening. I’d have felt less smug had I realised just how poorly I had configured the software. Important aspects of the solver, mesh and turbulence models were incorrect and, ultimately, had to be corrected. Fortunately, ignorance stopped us being daunted.

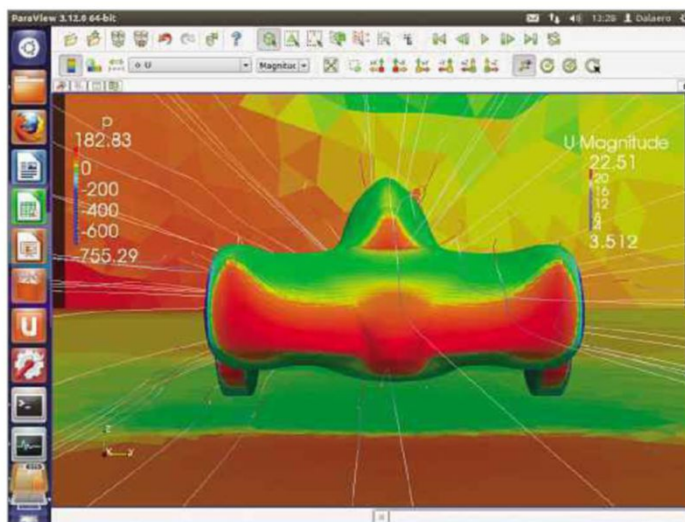
Having proved the concept, the project needed funding – and more effort than my work commitments allowed. My brother’s business partner identified a potential source: the Niche Vehicle Network (NVN).

The NVN promotes the development and application of new technology by bringing together independent vehicle manufacturers, system suppliers, automotive technology companies and higher-education institutes, to collaborate on the innovative application of technology in low-volume vehicle production. Following discussions, NVN generously agreed to fund a programme of work, codenamed ASTAN, with the following scope:

1. To produce a practical tandem-seat small car body shell shape, with exceptional aerodynamic drag performance to enable a working car to deliver groundbreaking fuel efficiency and low emissions.
2. To deliver this challenging task to a high standard with limited resources of both time and budget, by using open-source CFD software and a low-cost multicore PC network.
3. To build and test a full-scale prototype body shell in a wind tunnel and assess the accuracy of the CFD model.

Of these very challenging objectives, the timescale was the most daunting. Approval came a month before ASTAN was due to start. We then had three months to complete the study before the tax year ended. My work commitments meant that the project-management load fell on my brother’s shoulders. We had to identify specialist aerodynamic support, establish a computing

BELOW The team discarded 40 different shapes before finding the right one, here shown with pressures and velocities from the front



infrastructure, optimise the shell shape, find someone to build it, and then get it tested to confirm the CFD results.

Sheffield united

For specialist CFD support, we engaged Professor Ning Qin and Dr Jason Chen of the Aerodynamics Research Group at the University of Sheffield. They provided exceptional support. They scrapped much of my original setup and replaced it with a theoretically sound analysis environment. The only non-open-source component was the mesh generator, as the learning curve for the delightfully named OpenFOAM snappyHexMesh was not consistent with our timescales.

While Sheffield has a 120-core cluster computer with a lot of capability, access was an issue. Instead we decided to scale up the Monster setup. We bought four unbranded PCs, each totting a 3.5GHz Core i7-3770K CPU, with 16GB of RAM and a 1TB hard disk. Lacking the sophistication of the Dell box, and with fans that sounded like hairdryers, they nonetheless provided exceptional multithreaded performance. They ran intensively for four weeks over extended periods without issues... once we'd earthed the four PC cases together properly.

We used a cheap eight-port Gigabit switch to provide network connectivity. If anything, this was a bigger revelation than many of the other things we achieved. It shovelled all the data we needed reliably throughout.

Once my brother had worked out the intricacies of parallel computing across multiple nodes (one of many firsts for him), we had a standalone cluster of computers that could service 32 simultaneous parallel threads - quite a step up from a single T6400. Processing times tumbled from several days to a few hours. Our problems stopped being infrastructure and became design and manufacturing.

We ran a wholly digital workflow. Shapes were modified on my laptop in Blender and exchanged electronically with Sheffield. By the time we finished, we'd drawn, assessed and

rejected almost 40 different shapes. Valuable confirmation that the shell should fit was achieved by generating full-sized cross-sections from Blender and comparing them with the car. The final shape was very different from my initial sketches. The bright guys at Sheffield were quietly optimistic that the figures would be excellent.

Our next challenge was to make a foam buck to use as a mould for the final shell and also as a full-sized wind-tunnel model. Following design-freeze, the final shape was machined in foam. The result was excellent, apart from being made of polystyrene - one of our few mistakes. It turns out polystyrene collapses on contact with resin, becoming a gooey mess. We had to protect it with a hard coating, which added hugely to the time: this had to be applied and then smoothed. If we'd used polyurethane, which is insensitive to the resin, we'd have saved a lot of hassle. We were very lucky to find a mould builder who tirelessly worked to make us a shell and bore the brunt of the consequences of our decision to opt for polystyrene.

The missing piece

The final piece of the jigsaw was Warwickshire-based Mira, which provides a variety of testing services to the automotive industry. For ASTAN, we wanted to use its wind tunnel, measuring 15 x 7.9 x 4.4m (WDH).



TOP The raw foam buck prior to surface prep

BOTTOM The final sample in the Mira wind tunnel, complete with smoke to show the aerodynamic effect of the prototype model

"The days where useful work can be undertaken only by large teams with huge IT budgets are over"

It's as impressive as it sounds, with four 250kW fans, although it's pretty cold in March. Mira also provided a great deal of technical support, both in terms of how we might best use the wind tunnel and how to set up the CFD to reflect the wind-tunnel conditions and ensure a fair comparison.

Testing day was the first occasion on which the team had come together - another testament to the power of technology. Following installation and calibration, we started to gather real data. We collectively held our breath. Some of the features we'd introduced into the shape were fairly aggressive aerodynamically. The CFD said they'd work; the humans had doubts...

The computers were right. We'd achieved a shape with a drag coefficient of 0.18, a third less than that of a typical production car. Furthermore, the CFD results were within 5% of those of the wind tunnel. Outstanding under any circumstances; even more so given the complexity, novelty and time pressure of the ASTAN project.

Lessons to be learned

ASTAN taught us many things. For me, the most profound was what it said about my profession. Today it's feasible for small teams of motivated, vision-driven engineers to tackle previously "impossible" problems. The days where useful work can be undertaken only by large teams with huge IT budgets are over: the only limit is your vision, skill and drive.

ASTAN also highlights some brutal facts of CFD, which will always have the capacity to consume all available computing power. The ASTAN setup maxes out at 6 to 7 million cells per machine and relatively benign flow conditions with limited areas of flow separation. More complex geometries inexorably require more power. However, it also demonstrates the level of flexibility, modularity and extensibility of these tools.

CFD results will also always require validation for complex separated flows such as this one. Such validation requires physical models. Cost inevitably follows, but the value of testing at Mira was immense, and ASTAN demonstrated that a digital path to manufacture is readily achievable. Computer-driven analyses score in the 40 versions that don't need to be expensively built and discarded.

Whatever your field, the relevant high-quality tools are probably just a search away. The only prerequisite is to have the idea and to ask the question: "How hard can it be?"

dodo-research@hotmail.com

DAVEY WINDER

“I discovered unencrypted data was being sent to China by a battery-usage app”

Do you really know what your apps are doing with your data? A few tools can help you get a grip on your mobile security

Kofi Annan, former secretary general of the United Nations, once said “knowledge is power, information is liberating”. This certainly applies to technology, even more so the technology in your hand. Are you aware of the permissions you’ve granted apps on your smartphone and tablet, and what they’re doing with those permissions? Chances are, you don’t – and liberating those apps to do what they like greatly diminishes the power you have over your privacy and data security.

What set me thinking about this was some advice that recently appeared on the *PC Pro* website, the aim of which was to help readers to better understand their data allowance under iOS 8 ([pcpro.link/246dw](#)). This isn’t something that’s of great concern to me, since I’m on true unlimited data plans for both my smartphone and tablet. What does bother me, however, (and should bother you) is what data those apps are shoving around and where they’re shoving it to. For example, malware needs to communicate with its external server in order for its perpetrator to profit from the infection, whether that profit is paid in stolen data or resources.

So, here’s how to determine what’s using data (and much more besides)



Davey is an award-winning journalist and consultant specialising in privacy and security issues
@happygeek

“Opening NowSecure reveals at a glance which apps aren’t being as secure as you’d like”

BELOW NowSecure tells me my data is 87% secure – is that secure enough?

on your Android devices. If you dig into the Android system settings, there’s plenty of information available to users about permissions granted and what data is being used by which apps, but making sense of it isn’t always easy. More importantly, such raw system information doesn’t provide enough knowledge with which to power your decisions about what apps to use. What you need, ironically, is yet more apps...

The first of these apps is NowSecure, which is best described as an application activity visibility monitor. Catchy, I know. Immediately following installation, it won’t tell you much: it needs to sit in the background and watch for a while before it becomes useful (or displays any information at all, for that matter). After a week or so, it will begin to supply information about the security of your connections, the specifics of each app’s communications, and even the geographic location of your data, in order for you to be better informed about your apps.

You’ll first see a screen displaying a fairly arbitrary “security score” that’s calculated from what proportion of your network traffic is secure; whether your device has been rooted; whether there are any unverified apps installed, and

whether these can be debugged over USB; and if it’s connected to any insecure Wi-Fi networks. As with many such score-based applications, I took the resulting number with a pinch of salt – and you should do the same – but feel free to drill down by tapping on the score itself and then on the various

categories listed. Don’t expect a great deal of detail at first: on my first glance at the security category, the app merely informed me that the majority of my network traffic is encrypted; it would have been more useful to see which parts of my traffic are unencrypted.

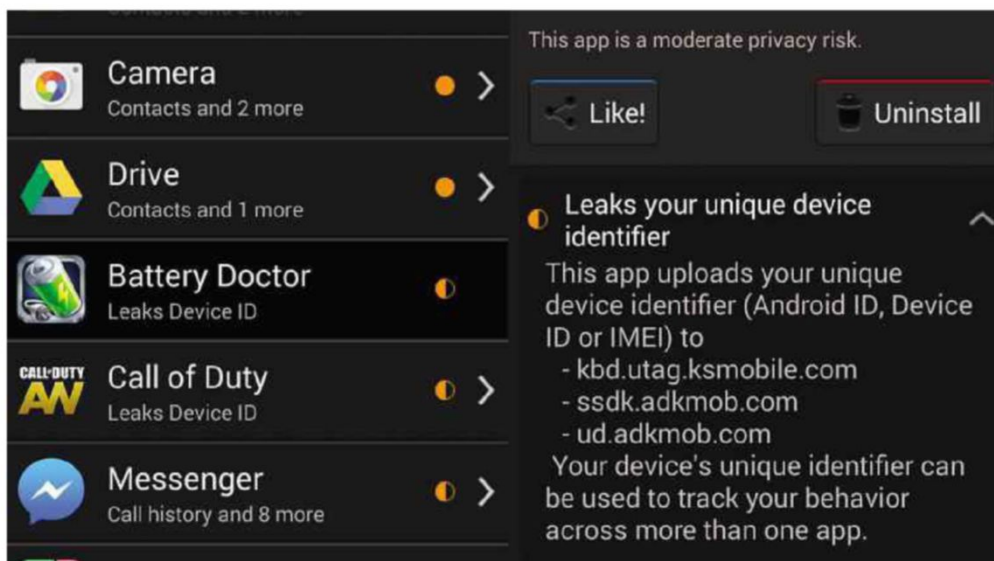
With this being so, you may be wondering why I’m recommending you install this app. Well, it’s because the useful detail comes from elsewhere. Not from the Security Feed section, which seems to merely be a vehicle for promotional news about the product, but in the Data Security section, where the power of NowSecure starts to reveal itself. It’s here that I gained information on which of my data was being sent unencrypted. Opening it reveals at a glance which apps aren’t being as secure as you’d like, and this app activity can be viewed as it’s happened today, or over the course of the past week or month, to achieve a more meaningful portrait of risk.

I discovered that my data is 87% secure. Of the 13% that’s unencrypted, Google Search was the biggest offender, responsible for 71% of unencrypted traffic on my test device. Second in the list was the operating system on 9%, followed by a battery-charging monitor on 7%, and then a bunch of other stuff on 1% or less, which includes Facebook, Chrome, Amazon and eBay.

The depth of detail also covers where my unencrypted data is being sent: not surprisingly, with Google as the main offender, some 47% of it ended up in the USA, but 14% went to the Netherlands and 6% to China. Heading back to the main menu and selecting “Countries” allowed me to drill down into this geolocation aspect of data usage, across all apps and in further detail. Destination countries are listed by the volume of data received, again on a daily/weekly/monthly basis at the click of a tab, which confirmed that the USA is where 71% of my data was ending up. Clicking on the country name reveals which apps are doing that particular talking: once again, as expected, Google proved responsible for 69% of traffic, although only 15% of the overall traffic was unsecured.

Taking a look at China enabled me to discover that not only was an alarming 100% of my data being sent there unencrypted, but that 95% of that traffic was as a result





of a battery-usage app I'd installed. This is information I'd never have known about without the NowSecure report, and while it doesn't necessarily indicate a security or privacy threat per se, it certainly presented me with food for thought.

The final option available through NowSecure is "organisations", which reveals exactly who your apps are talking to – expect this to be a mix of ISPs and advertising hosts. Once again, any unknown or unexpected names can be drilled down into to see which app is talking to them and whether or not the data being sent is secure. You can also then Google the organisation for more information.

NowSecure is a free download from Google Play, but that doesn't mean it comes without a cost. It's just a cost to your system resources; of all the apps installed on my Android device, NowSecure has become the biggest resource hog, responsible for running the battery down faster than any other app. Information at the cost of power is perhaps a good description. In fact, I uninstalled the app after a month of testing as a result – I'd recommend you use it as a report-building tool, leaving it for a week or so to gather data. Spend some time interrogating the results before uninstalling it again to save resources. Repeat this install-for-a-week treatment once a quarter to keep on top of where your data is going.

Get a clue

The second app I installed to gain insight into what my other apps were up to comes from security vendor Bitdefender, in the shape of a free download called Clueful. Like NowSecure, Clueful hits you with an overall privacy score, which in my case was a less-than-comforting 57%, described as only "fair". This score is apparently calculated from the "danger level" of the apps I have installed, and Clueful warns that "the lower the score, the more dangerous are your applications and you should take the necessary steps". How does Clueful come to this conclusion? Actually, it's quite simple: it checks the permissions you've granted to each app (those ones you should think about before clicking the Install button) against Bitdefender's cloud database, which holds data on what previously scanned apps are actually up to.

The idea is that you can then make an informed choice as to whether you believe the ratio of potential privacy risk to resource reward is sufficiently favourable on an app-by-app basis. Once again, I'll admit to treating this main-screen privacy score as arbitrary, feeling inclined to ignore it. It would be far more useful if I could inform Clueful that I do trust certain apps, based on my own assessment, and then have my privacy rating adjusted accordingly. However, if you scroll down past the big target that occupies most of the screen, you'll see a breakdown of the

ABOVE What data are your apps sending, and to where?

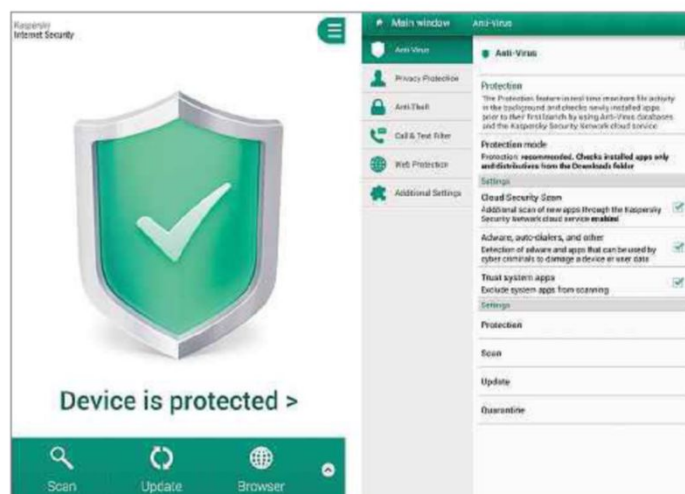
"If you use Clueful with NowSecure, you can build a broader image of your 'privacy-scape'"

BELOW Antivirus has now become an essential install on all mobile devices

risks – my test device showed I had 39 low-risk apps installed, 22 moderate-risk ones, and none considered high-risk. This immediately suggests the situation isn't all that bad, but digging into the detail is obviously still required. I opted to take a look at all 69 apps installed on my device, and one click opened up a vertically split screen with my apps listed in order of apparent risk on the left, while details of the risk are displayed on the right. I could see that my calendar app had permission to read my contacts list and my calendar entries, which Clueful considers to be a moderate privacy risk, but that common sense says is clearly a requirement for any calendar app. I'd have expected that these would have been classified as low-risk "expected behaviour", in the same way Clueful understands that Messenger requires permission to send and receive SMS messages.

This doesn't mean that Clueful is a complete waste of space, merely that you need to apply a little common sense when interpreting the results. Remember it isn't telling you which apps you ought to remove, but rather providing data about them to enable you to make an informed decision.

Where things become really interesting is when you use it in conjunction with NowSecure to build a broader image of your "privacy-scape". If we go back to that battery app NowSecure informed me was sending unencrypted data to China, Clueful shows only one concern with it, namely that it "leaks device ID". Clicking on this in the right-hand screen enabled me to delve deeper, revealing that the app uploads my Android ID, Device ID or IMEI to a number of specific servers registered to Chinese companies. A little extra research revealed one of these to be a mobile-tools provider, while another



Continued from previous page

appears to be an ad-serving/tracking network. Neither would suggest much to worry about, but Clueful's advice that a unique identifier can be used to track your behaviour across more than one app is certainly useful.

I like the way Clueful displays its privacy information, and the fact that I can opt to uninstall any offending app without even leaving the app. I also like its filtering option, which quickly enables me to show only those apps that present a specific risk. These risk filter topics range from using intrusive ads through to tracking your location and gaining access to sensitive data. The number of apps, if any, which are found to match is displayed to the right of the filter category, saving you from wasting time looking into empty categories.

However, the number of apps not being analysed does concern me. You can see an Analyse button next to them, but pressing this just tells me that Bitdefender will try to analyse this app as soon as possible. Considering that some of the apps here are pretty popular (Nova Launcher Prime, for example), this strikes me as a weakness.

Overall, though, Clueful can fulfil that "information is liberating" brief – especially if used in conjunction with an occasional NowSecure scan. Keep in mind that neither is a security app in the usual sense of performing malware scans, so you should still install such software alongside them. That's right, I'm saying that common security sense nowadays dictates the need to install a complete mobile security suite on your device.

There are a huge number of such security apps out there, from the free to the hugely overpriced. Among the best value, in my opinion, are those multi-device suites that allow you to install protection across device types and operating systems, offering you the same protection on a couple of laptops, your smartphone and tablet with a single licence (see our group test on p80). On the mobile device, your Android app will most likely include antivirus/anti-malware protection, along with some kind of anti-phishing filter and a theft/loss data wipe and geolocating function.

davey@happygeek.com

STEVE CASSIDY

"I know that everybody loves a rant and a disaster story, so let's get to that part first"

Two traumatic recovery processes leave Steve unsure how to feel about the state of the technology industry

I don't know whether to laugh or cry. Literally, such is the state of life in the information technology business at the start of year 2015. On one hand, I've just witnessed a classic story of hardware failure that's enough to make you despair for the whole industry. On the other, I've been able to use some clever software to get out of trouble – in ways that give me hope for the future, not only of our own business, but of the multitudes of businesses that have become painfully dependent on us (in ways that, even two years ago, nobody saw coming).

I know that everybody loves a rant and a disaster story, though, so let's start with that part. In what follows, I may perhaps be accused of navel-gazing, since my rant touches on product reviews, an area in which *PC Pro* itself has a certain interest. Really the story is about knowing how far you can trust your own hardware, and in this case I'm thinking specifically about storage devices. To a degree, reviews of such boxes all tend to ask and address a similar series of



Steve is a consultant who specialises in networks, cloud, HR and upsetting the corporate apple cart
[@stardotpro](https://twitter.com/stardotpro)

questions, based on the reasonable assumption that the list of factors relevant to your business remains fairly constant. We also accept that the manufacturer's representations of how you'll use the device, and how it will behave, align more or less with what's important to your operations.

When it comes to a buying decision, however, it's important to bear in mind that the parts of the review that seem most important may in fact be red herrings, while less sexy but crucial considerations might be understated. In a comparative review, there's a natural inclination to view performance as the key differentiator – an understandable instinct in an industry that has for decades measured progress in terms of operations, frames or bits per second. Storage manufacturers themselves like to focus on performance claims as a means to distinguish their products.

BELOW Fast transfer speeds are great – but what happens when a drive fails?

These days, however, the raw speed of the chips in terms of bit-shovelling needs to be considered alongside relative power-efficiency. The good news is that the low-energy movement is already paying dividends: data-centre and server-room design is becoming easier, and ongoing per-unit running costs are falling. On that inevitable mid-summer day when the air conditioning dies, you'll be grateful for your VM management and your power-efficient post-Xeon 5500 Series servers.

This brings me to the real point of my rant: if you believe, as I do, that IT is only becoming more fundamental to businesses, then it's absolutely crucial to consider not only how a piece of kit performs when all is well, but also how it will cope with the grungiest of real-world operations and scenarios.

For a business, that's true of almost any type of product, but it applies particularly to storage. We're stowing away an unprecedented amount of data, and our interactions with these huge piles of data increasingly resemble needle-in-a-haystack



exercises, such as picking out that vital seven-year-old, two-page document from the irrelevant terabytes of gossip emails, holiday photos and backups of unused website designs (which may turn out to be tomorrow's vital document).

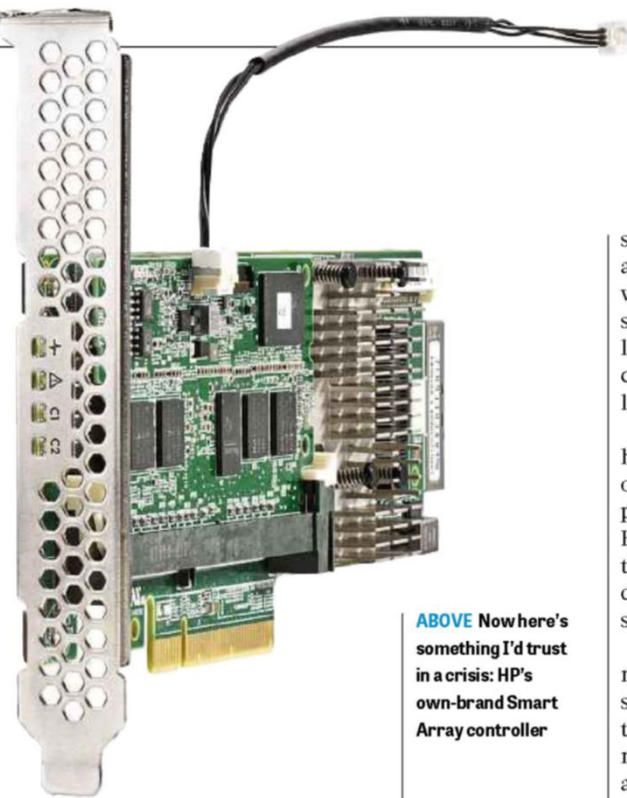
This kind of contingent usage pattern can result in performance that bears little resemblance to benchmark scores. Recently I've seen a bottom-end NAS device achieve impressive transfer speeds when given a few gigabytes by Windows Server 2012, reporting data rates of as much as 500MB/sec across a bonded Gigabit Ethernet, using jumbo frames, flow control, iSCSI and separate LAN cards for the front-end and back-end traffic inside the server. Change the test data from a single file to a messy directory tree, however, and speed plummets. Another test on a single 100GB VHD showed a similar performance level: small, single files can zoom down the pipes, but once the workload starts to overwhelm the available memory cache, sploosh, into the swamp...

In this case, though, I'm not just talking about how challenging usage patterns can destroy a device's advertised transfer rates. I'm writing in the aftermath of one of those awful horrors that leave senior management swearing never to use a particular platform again.

Here's how that came about: this month, one of my clients discovered to their horror that their main server didn't have a mirrored boot volume – and the controller was reporting that the surviving half of the original mirror was on its last legs. Their on-site tech specialist certainly wasn't going to ignore the predictive failure monitoring of the RAID card, but for some reason decided he didn't trust it to re-mirror a live boot partition.

I partly sympathise with his wariness, because the experiment to discover whether or not one has a trustworthy boot config is about as edgy as experiments get (short of those two blokes on *MythBusters* with some gunpowder). There are plenty of horror stories involving otherwise trustworthy server vendors who decide the best way to cut production costs is by skimping on the basic requirement to keep the customers safe, no matter what sort of fit the hardware may throw.

And it's the way of such horror stories that the long tail of bad reputation becomes a bit like the rear end of a brontosaurus: there's the real part, composed of plenty of red gristle and white bone, but then there's also



ABOVE Nowhere's something I'd trust in a crisis: HP's own-brand Smart Array controller

the shadow it casts, which, although wholly insubstantial, appears far larger and more intimidating. Stories about a single version of Dell's PERC controllers and its broken boot-volume handling are of exactly this sort: with one prehistoric bad experience hanging in everyone's collective memory, all of Dell's RAID cards suddenly came to be treated as untrustworthy.

In fact, in my client's case, the techie's fear was focused on the least deserving suspect, because the server was an HP ProLiant of the almost-universal G5 generation. HP servers can be specified with own-brand Smart Array controllers, which have earned my almost complete trust. Just like those Dell PERCs you're likely to find in the wild nowadays, HP Smart Arrays can be tested by simply looking into the Array Configuration Utility (in case there's one dead member already), then yanking a member drive out of an array and plugging it back in again. The array controller will start to jump about like a cat chasing a laser pointer, and then the array will slow down a little as the controller quietly gets on with resyncing the drives.

That's all the upheaval you'll see, and this is how RAID is meant to work. And I don't mean only top-end storage controllers in big DAS deployments – the very essence of RAID is that all this stuff is supposed to work that way. Yet the very sad truth in 2015 is that almost nobody in our business acts as if this were a reasonable thing to be asking for!

Thus, my client's local techie didn't simply rip the cellophane from a brand-new 147GB SAS disk and let the controller get on with re-mirroring it. Instead he took down the server and

set about cloning its partitions – agonisingly slowly, because HPs built with certain releases of SmartStart software have an unobvious partition layout on their boot disks. Then he created a whole new boot array to layer these partitions back over.

Since he hadn't built this server himself, nor done any torture testing on it with this specific setup, I can perhaps see why he chose this path. But really, must we persist in believing that the data integrity of RAID storage devices is something made up only to sound good in sales pitches?

It's perhaps noteworthy that the majority of the storage failures I'm seeing recently are no different from those that happened back in the noughties. Something goes bad inside a SATA disk, but rather than fitting neatly into those faults that SMART monitoring and reporting can cope with, this badness manifests itself as a low-level electrical fault that stops the power supply – and hence the rest of the device, including the other disks in the RAID array – stone dead in its tracks. Nothing is left running, nothing can recover automatically and no clever alarm-raising features can be used, because the problem is a shortcoming in the entire SATA specification. It's such experiences that teach us not to trust the superior feature sets in basic disk management.

To take just one example: if you read up about those early Iomega ix2 NAS boxes, you'll find numerous customers lamenting that when their bargain-basement SATA disks gave up the ghost, their equally simple-minded RAID controllers wouldn't rebuild the set with anything except an absolutely perfect identical twin of the dead member disk. Of course, having been bought at the very cheapest end of the market, such a twin was no longer available when the failure occurred.

Similarly, as I discovered over the Christmas break, there's a rich vein of complaint threads in the Netgear NAS support forums that all boil down to bottom-end devices failing to properly recover from a drive falling out of sync. Normally, if you have a dead NAS, and you suspect this problem – that one of the drives is holding the rest to ransom for purely electrical reasons – then your best course of action is to pull the drives out of their cages one after another, as I used to do with HP Smart Array RAID5s. However, Netgear's ReadyNAS OS responds to such attempts by declaring that it isn't only one that's drive dead, but in fact it's two! With a four-drive NAS, this

“The majority of the storage failures I'm seeing recently are no different from those that happened back in the noughties”

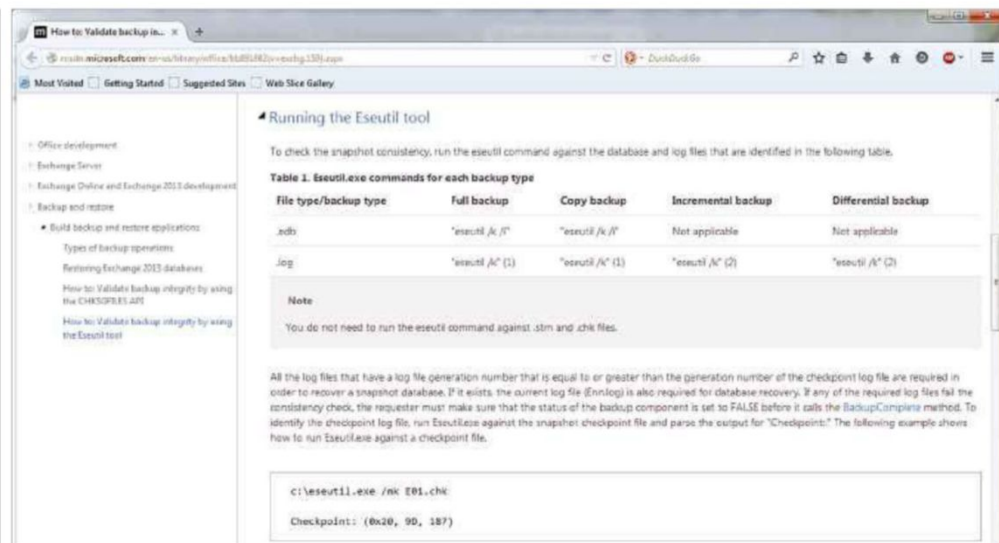
can easily lead you to believe that all your files are history, because the OS doesn't consider whether the problem could simply be your having popped out the wrong drive. It tries to direct clients to a web UI, but says as little as possible on its small onboard status screen beyond a curt "restart failed".

In the case of the failure I attended to over Christmas, the device did end up recovering itself, but only after an epic volume reconstruction exercise following the reintroduction of that third crucial drive. It seems as though a SATA bus failure had caused the firmware to think that drive 4 was dead, when in fact the culprit was drive 3. As soon as drive 4 was taken out and put back with drive 3 removed, reconstruction could proceed – albeit in a somewhat bloody-minded way. Even though the 6TB of available space was less than 10% occupied, the RAID re-structor whirled away for more than an hour before remounting its volumes, as we discovered by refreshing the management interface every ten minutes or so. The recovery was eventually completed roughly nine hours later.

You can see why this might make a person want to cry. The combination of somewhat hopeful promises, minimal progress information, woefully scattered and inaccurate user-written "documentation" and colossal datasets makes for an unhappy recovery process.

This isn't the sort of scenario a review will necessarily focus on. Nor – perhaps understandably – is the RAID rebuild process often given prominence in vendors' claims for the capabilities of their hardware.

All the same, if you can, before investing in a NAS system, it's important to find out everything you can about array failure and recovery behaviour. You could even test it yourself: this needn't require sitting with stopwatches and sandwiches at unsocial hours. If you can get your hands on a test unit, simply yank out a drive, wait for it to spin down and then re-insert it, before logging in to its management pages to see what the machinery has to say. Drives fail, and there's nothing that can be done about that; good reporting of a bad situation is the ultimate recommendation.



You're laughing, squire

That's enough of the crying. Now let's get onto the laughter, which actually arises from these same merry incidents over the Christmas break and just before.

If you're involved in network management at all, you'll be familiar with the great efforts that sales droids and cloud architects regularly put into warning us about how fragile and awkward our poor old Windows servers are. And they may have a point – if you're misguidedly trying to wring the very last squeaks out of your creaking pre-recession hardware and software.

My own experience however has been that, in all my years of running around after apparently dead disks, and generating volumes of war stories concerning disk manager firmware in the process, the actual data saved on such drives has generally proved surprisingly robust.

At least one of the dramas I've recently stage-managed to a happy conclusion concerned an Exchange 2013 message store, which – as the result of a penny-pinching decision to avoid investing in rack-mount hardware – had been kept and updated for several months on a cheap and cheerful external NAS with marginal iSCSI ability.

It was impressive, really, how well this setup endured the considerable abuse that was regularly meted out to it. People pulled out Ethernet leads; they yanked out the power connector by mistake; they ignored update requests; they thrashed the poor disks by copying huge volumes of messages around from private to public mailboxes. It added up to the worst torture test I could ever imagine for such a storage system.

ABOVE Credit to Microsoft, it has invested time and money in getting its server tools right

"This level of recoverability in a badly treated NAS gave me considerable hope"

Remarkably, though, this budget iSCSI target device withstood everything they threw at it – right up to the point where it finally threw up its hands and dropped a RAID disk.

Exchange coped with this admirably. It reconnected on a reboot of the guest VM and undertook only an occasional bit of database repair, without the users being aware that anything had happened. I was sure, however, that if the RAID array needed rebuilding, it would be game over for the innermost layer of this pyramid of storage types – a ReadyNAS logical volume, containing a thin-provisioned iSCSI LUN, containing a Windows Hyper-V host NTFS drive, containing a Hyper-V guest logical disk, containing the Exchange message store itself.

I was wrong! Once the array had been green-lighted, everything started back up with the barest of delays.

When I cast my memory back to the bad old days of bleeding-edge server management, such recoverability (on a network cobbled together, I remind you, from non-specialist equipment with a minimum of clever tuning tricks) gives me considerable hope on two fronts.

First, I feel encouraged that Microsoft has evidently done the right kind of work in understanding where to expend its development efforts, so that a failure in one area of your systems doesn't necessarily mean everything else comes tumbling down.

Second, I'm heartened to see that it's now possible to take advantage of technologies once reserved for heavy-metal data centres in the smallest of desktide deployments. That's the best possible kind of server and networking innovation: the kind that delivers peace of mind.

cassidy@well.com

ON SALE NOW

MAGBOOK

**NEW
EDITION**
Create a killer
business
plan

START YOUR OWN **SUCCESSFUL** BUSINESS

START TODAY!

From finding the money
to developing your idea
into a sellable product

GROW TO SUCCEED

Find new customers, keep
them happy – and make sure you
expand at the right rate

KEEP MONEY ROLLING

Discover how to take
control of your cashflow
and ensure you get paid



**ONLY
£9.99**

Order your print or digital
MagBook at **magbooks.com**



We explore the trends and technologies that are set to shape the future

Light-speed PCs

Researchers develop materials to create all-optical computers **p126**

MU-MIMO

The technology that's bringing faster and more efficient Wi-Fi **p127**

Geek Day Out

Get hands-on with more than 1,000 classic computers **p128**

Kick-starting the UK's start-up revolution

Nicole Kobie reveals how the new Digital Catapult Centres are helping tech companies find their feet



The government is fascinated with the potential of start-ups, investing millions into schemes to help kick-start the next Google. Efforts have largely focused on East London's Silicon Roundabout (also known as Tech City), but start-up support is beginning to spread nationwide thanks to new Digital Catapult Centres.

While that name may sound like it was created by an Old Street marketing team, the first centre opened its doors last November near King's Cross station in North London; now further centres are to follow in Bradford, Brighton and Sunderland.

Digital Catapult is funded by the government's Innovate UK quango, which provides support to companies with IT-themed ideas. Neil Crockett, CEO of Digital Catapult, explained the aim is to help "small guys overcome development challenges" so they "don't have to go to the US" to succeed – a point hammered home by a board of British heavy hitters that includes names such as Warren East, former chief executive of ARM.

Crockett stresses that Digital Catapult isn't an accelerator or an incubator, which normally involve funding. Instead, the focus is on taking good ideas by people with sound tech credentials and helping

them turn those clever innovations into businesses. They receive practical assistance on taxes and copyright law and, rather ironically, help applying for government contracts (see *Government barriers, opposite*).

■ Four challenges

Admitting that "digital" is too wide a remit to cover well, Crockett said that Digital Catapult is focusing on the challenges surrounding data. "The collection, the transport, the analysis, the insight, the visualisation of data – that is what we're calling our field of play," he said.

Crockett cited a lack of openness as one of the main problems, claiming that as much as 90% of data is locked down or proprietary. "We're blessed in the UK to have some of the best

thought-leaders in open data," Crockett said. "We want to work on four challenges to try to help the UK become the front-runner in creating innovation and sharing closed or proprietary data in faster, better and more trusted ways."

Those four challenges are copyright; trust for personal data; sharing business data; and the Internet of Things. According to Crockett, creative content is key to the first challenge. "I always thought that if the UK were going to have a Silicon Valley, it would be something to do with creative content," he said.

However, the "mechanisms" of copyright – such as getting and checking licensing – are "very cumbersome". To aid, Digital Catapult is helping to develop the UK's Copyright Hub, which aims to make it easier to find owners of content and ensure they're paid for it. "No-one else was getting on with it because no-one else could see personal value in it," he said.

Second, Digital Catapult is working to encourage people to share their personal data by creating tools, architectures and business models that build trust, alongside setting up a voluntary code for British firms "so we can aspire to what is good". Crockett said it would be from personal data "that the next wave of digital innovation will come, so we have to solve that problem."

Companies need to be encouraged to share their data, too. "If people shared the data that's sitting inside their organisations, they might find better ways of running their supply chain; even though they're sharing data with a competitor, they all might benefit," Crockett suggested. To help, Digital Catapult is setting up "safe zones", where competing companies can pool their data and let trusted organisations access it to show them how to use it better. "The bigger companies get more confident, and the smaller ones get an opportunity to show what they can do," Crockett said.

BELOW Neil Crockett, CEO of Digital Catapult, hopes the initiative will help to create more "leading" businesses in the UK





Government barriers

Digital Catapult has been asked to help start-ups apply for government contracts. Despite the government pledging to cut use of huge contractors in favour of SMBs, and its support for tech start-ups, public sector bids remain difficult for smaller companies to apply for, let alone win, according to Jonathan Raper, founder of Transport API, one of the start-ups supported by Digital Catapult.

He said the public sector is very "risk-averse", so bid applications have set scoring factors: you receive more points if you have a health-and-safety advisor and environmental accreditation, and are a certified considerate contractor. It's unlikely that a start-up will have such qualifications, which are surely overkill for merely supplying a



data stream to city planners? As a result of such barriers, Raper has already decided not to submit bids for at least one council.

This doesn't mean his start-up's data is lost to the government, however: a large tech supplier could win the bid and then subcontract it to his small business. This route will result in higher costs for the government, though, and will be less valuable to Transport API, he said. "It's a lose-lose situation for everyone except systems integrators," Raper concluded.

ABOVE The first Digital Catapult Centre opened in King's Cross in 2014

The last challenge is the Internet of Things (IoT). "This is a revolution in which the UK should be a leader," Crockett said. "We have world-class researchers and universities; an inventive entrepreneurial environment; we have real strength in data science; we're strong in the verticals – energy, transport cities. We're good at this."

Saying it's a "global race" to lead the IoT, Crockett argued that the UK needs a "joined-up approach" to research, as well as "large-scale test beds" so that products can be brought to life more quickly. "If we don't, we're going to once again create the ideas that everyone else commercialises," he warned.

Addressing these four areas will help "the small guys" overcome development challenges, and "get the big guys to see that, instead of going to the west coast of the US, or Korea, you can come to the UK and find a wave of open innovation and brilliant ideas," Crockett added.

This is key not only to those trying to build a business in the competitive tech industry, but for the rest of the UK too. "If we don't take this opportunity, we're not going to lead the next wave in digital – we're just going to be its consumers," he warned. ●

Three start-ups worth watching



iGeolise

iGeolise is a new way of searching for locations: it makes maps searchable by travel time, pulling in data on public transport, driving, walking and even cycling. Co-founder Peter Lilley told us that 40% of web searches are for items with a location, such as a shop or property. "If you're going to travel, you care about time."

The technology is already used by VisitBritain as well as home-hunting websites Zoopla and Countrywide. For example, you can look for a new flat based on neighbourhoods that are no more than 30 minutes from your place of work.

Cycling is the hardest to figure out, Lilley added, since it's tough to average travel times of the "basket brigade versus Lycra louts".



CueSongs

Some bright ideas are very specific: CueSongs makes it easier for musicians and rights-holders to license music for use on YouTube. Co-founder Ed Averdieck – with Peter Gabriel – explained that online video production is growing "ballistically" and, while royalty-free music is available, many YouTube stars want to use better-known songs.

CueSongs lets short clips of songs be used on a one-off basis for reasonable fees. "It's a cost-effective way to get legal music", said Averdieck, noting that licensing for the web is tougher than for national broadcast, since you need to obtain global permission.

CueSongs currently holds 50,000 tracks, including songs by indie favourites The Temper Trap. Plus, to avoid copyright claims, YouTube whitelists videos associated with CueSongs, so producers benefit from not having to pay a slice of their earnings to the song owners.



ScraperWiki

Have you ever tried to extract data from a PDF or website? Then you'll be aware of the pain ScraperWiki is trying to avoid. Its tools make it easy to pull data from such locked-down and messy sources, and pump clean numbers into analysis software such as Tableau and QlikView, or use them to make interactive web apps.

The aim is to make it faster and cheaper to create data visualisations – "we're trying to make data accessible," CMO Aine McGuire told PC Pro – and the success of the tools is clear from ScraperWiki's work for the United Nations mapping Ebola. You can try out its PDF-scraping tools for free at pdftables.com.



Why the world needs light-speed computers

University researchers are currently working on components that will allow them to make all-optical computers that can process at the speed of light. Dr Richard Curry reveals the science behind the breakthrough and what it means for computing

DATA RACES OVER fibre broadband cables to your computer, only to slow to a comparative crawl as it's converted to electrical signals. This could be set to change, with researchers at the University of Surrey and University of Cambridge creating new materials to build the first all-optical computers.

The latest breakthrough sees the types of glass used in CDs and DVDs, know as amorphous chalcogenides, altered via a technique called ion doping, to form a material that can create, guide and detect light – and can therefore be used to build optical computing components.

Dr Richard Curry of the University of Surrey has been working to develop such materials for more than a decade. We spoke to him to find out what breakthroughs need to happen next, and how far into the future we can expect to see light-speed computers.

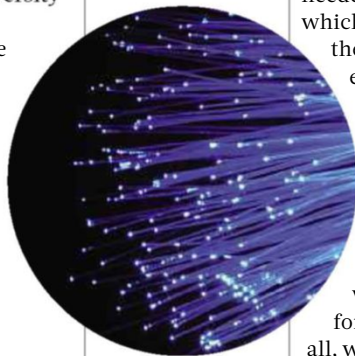
■ **Computers currently use silicon rather than glass.**

What needs to change for optical computing?

Your computer works on silicon, and then at some point, we turn it into lights and optical fibres to send over broadband, but when it gets to the other end, it slows down again. It's slowly converted back to electrons, which crawl along in comparison to photons. What we're trying to achieve is to ultimately not



RIGHT & BELOW Researchers at the University of Surrey are developing materials that can create, guide and detect light



BELOW Glass used in CDs and DVDs is being altered to form a material that can form the basis of superfast chips

have a conversion. I'd like to stop using [silicon] and electrons and use light instead, but the problem is we don't have materials that can use photons of light in the same way as electrons. We've been trying for years to do this.

■ **You've recently made a breakthrough with a new material. What key properties did it need?**

In this material, we needed to find a way in which we could actually control the light in the same way that in electronic materials we can switch electrons and send them to places or store information.

■ **What has to happen next for all-optical computers to be built?**

There's a series of devices that we have to demonstrate going forward. When you get them all, we can put them all together, integrate them, and then we can start computing with it. Currently we've built one of those devices, which is like a detector, so it can identify that light is there. Thereafter you need a source of light, so we'll work on that next; then it becomes more and more complicated. These materials have



an advantage in that we're already using them in our computers today for memory. So we already know how to use them.

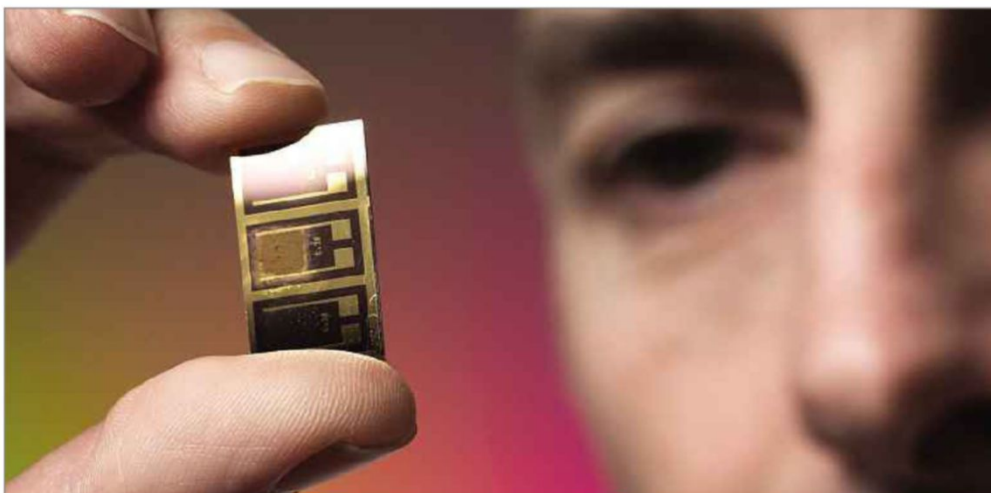
■ **How long until this technology is in computers?**

It's probably a ten-year path from here to getting an all-optical computer, but we'll see benefits before then because we can start by making a hybrid system, which is half light, half electronic. This will be better than what we have at present; there are gains to be had sooner, as well as the ultimate long-term goal.

■ **What will all-optical computers offer in terms of processing power?**

It will be the equivalent to, or better than the difference between, sending a letter via post and sending it via email. [It will be a] switch in capability: people developing drugs will have faster computers, way faster than what we have now, which will allow them to carry out far more complex calculations. The net benefits are huge.

What we need to consider is that all our devices are coming together – our phones, all the electronic gadgets that we have, even gadgets in the house are becoming more and more connected to the internet. This Internet of Things is going to require much greater ability to actually handle the data and process it, and this new technology will enable all of that to come to fruition. ●



What is... MU-MIMO?

Multi-user MIMO is finally arriving en masse, promising faster speeds for multiple Wi-Fi users, with hardware on the way from D-Link and Netgear



Wi-Fi is about to get more efficient – and therefore faster – for all those connected devices we have in our homes. D-Link and Netgear were among many companies at this year's CES to announce routers with support for MU-MIMO, part of the second wave of the 802.11ac specification. Here's how it works and what it means for you.

What is MU-MIMO, other than an acronym that's fun to repeat?

MU-MIMO not only sounds like a character from a children's television series, it's our favourite new tech term, thanks to its multiple use of the word "multiple": it stands for multi-user multiple input, multiple output. While plain MIMO time-slices the data if you need to send a signal to multiple devices – that is, it exchanges data with one device at any one time, alternating between them – MU-MIMO takes full advantage of the multiple antennas on connecting devices. So, if your router has three antennas and you're connecting a two-antenna laptop and a one-antenna phone, the signal will be sent at the maximum possible speed to both devices.

What does that mean for users, other than adding another confusing marketing term for routers?

If you're using a MIMO router, you may have noticed a slowdown as more devices have been added to the system. MU-MIMO is designed to get around this and make Wi-Fi more efficient for multiple users. You can also expect a boost in overall speed: D-Link's two new MU-MIMO routers offer up to 2.2Gbits/sec on the 5GHz band, the company said.

Sounds very whoosh. What are the limitations?

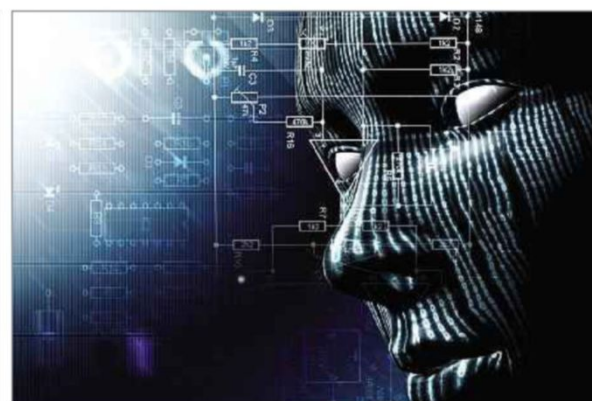
Sadly, you're not going to get that 2.2Gbits/sec bandwidth on every device you connect, since it still has to be split. Also, because MU-MIMO requires separated antennas and signal processing, it isn't a two-way street: it works only downstream, from the router to your PC or other device, not upstream.

Don't place devices right next to each other, either: MU-MIMO uses a system called beamforming, which effectively focuses the signal on each client device. In short, two devices in the same direction will share the same stream of data, but those in opposite directions will get their own.

The final limitation? Your access devices – the laptops or phones you're using to hop onto Wi-Fi – will need to support MU-MIMO, so you may need to update their firmware.

When will MU-MIMO get here?

MU-MIMO was approved as part of the second wave of the 802.11ac specification at the end of 2013, and routers that support the technology are already hitting the shelves. D-Link's sci-fi-looking AC5300 (pictured above) and AC3100 were unveiled at CES, although prices and availability won't be confirmed until the second quarter of the year. Netgear used the show to demonstrate its Nighthawk X4 AC2350 Smart WiFi router, which was first announced in September 2014; it's already available for \$280 in the US. Both devices follow the Asus RT-AC87U, which costs around £200 and became the first router to support MU-MIMO when it arrived last summer.



How to make AI do what we want

Researchers have agreed to work to ensure AI and related technologies help humanity

ARTIFICIAL-INTELLIGENCE EXPERTS have long warned that super-intelligent machines could – on purpose or inadvertently – pose a threat to human life. In an open letter signed by AI luminaries, including Stephen Hawking and Nick Bostrom, members of the research community have now pledged to ensure AI systems build in safeguards to ensure that our greatest invention benefits mankind, rather than wiping it out.

Dr Séan Ó hÉigeartaigh, an AI researcher who helps run the Cambridge Centre for the Study of Existential Risk, said such a pledge is necessary because recent progress in deep learning and statistical learning is increasingly raising troubling questions about machine intelligence. "It's no longer enough to ask 'can we build it?'," he told PC Pro. "Now that it looks like we can, we have to ask: 'How can we build it to provide most benefit? And how must we update our own systems – legal, economic, ethical – so that the transition is smooth?'"

Even positive results from AI could have "near-term challenges," he warned. For example, automation could affect jobs, robots could cause industrial or road accidents, and decisions must be made about the ethics of using autonomous weapons in war.

While Ó hÉigeartaigh sees "human-level" intelligence in machines as centuries away, he believes that it's necessary to build in controls now. "We need to start work on today's challenges – how to design AI so that we can understand it and control it, and how to change our societal systems so we gain the benefits AI has to offer," he said. "We can't assume we'll get it right by default."

"We have already seen unexpected behaviour from systems that weren't thought through enough – the role of algorithms in the 2010 financial flash crash, for example. It's essential that powerful artificial-intelligence systems don't become black boxes operating in ways that we can't entirely understand or predict," he added.



LEFT Researcher Dr Séan Ó hÉigeartaigh believes now is the time to address the challenges thrown up by AI

Geek Day Out

Are you in the mood for a bit of nostalgia? Then head to Leicester to feast your eyes on a collection of more than 1,000 working computers



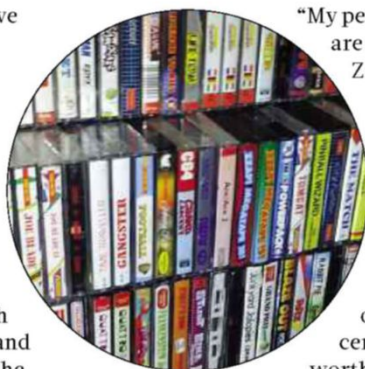
Image: leicestersnotshit.co.uk

Much as we love shiny new tablets and laptops incorporating the latest processor technology, classic machines will always hold a special place in our geeky hearts. If you agree, you have much in common with us, and with Andy Spencer, the founder and chairman of the Retro Computer Museum in Leicester.

Run entirely by volunteers, the RCM was set up in 2008 with Spencer's initial collection of 25 classic computers. Thanks to donations, that number has since increased to more than 1,000 machines ranging from classic Ataris to a virtual-reality system made by W Industries back in the 1990s.

A rotating selection of around 50 machines is on display each month; if you want to see a specific machine that's tucked away out back, just ask a volunteer staff member, who will fetch it for you.

We're happy to report that this is no stuffy, hands-off museum: all of the machines on display are in full working order, and you can use them.



"My personal favourites are the Sinclair ZX81, ZX Spectrum and the Commodore 64," Spencer told *PC Pro*. "There are way too many highlights to mention specific items – however, our collection of software is certainly something worth seeing."

For those of you

possession of an ancient machine that might be of interest to others, get in touch with RCM. The museum is always looking for donations, and those machines that aren't in working order can still be salvaged for spare parts.

The Retro Computer Museum is open most Sundays from 11am to 5pm; entry costs £6.50 for adults and £3.50 for children – visit retrocomputer-museum.co.uk for details.

The museum had an initial collection of 25 classic computers; there are now more than 1,000

ABOVE A blast from the past: there are classic computers aplenty at the Retro Computer Museum

LEFT The museum also has an extensive collection of software on show

Crowdfund this!

Our pick of the UK tech projects on Indiegogo

Exo FingerMouse

What is it? The Exo FingerMouse is a tiny touchpad that sticks to an Android smartphone, tablet or a set-top box.



Why would you want that?

Its makers point out that fingers smear your touchscreen and block your view of what you're trying to see – and it's sometimes awkward to use your touchscreen to flip pages or take a selfie.

And this solves that? You can stick the Exo FingerMouse to the back of your device, and use its tiny touchpad to flip through pages on your smartphone one-handed or take a selfie by tapping the rear of the device. Or you can pair it with an Android-powered set-top box to use as a remote control.

How does it work? It connects over Bluetooth to whatever device you're using – so long as it's Android 4 and up – so you don't even have to stick it to your phone or tablet. The makers suggest you could leave it on the arm of your "favourite reading chair, or in your hand". You'll have to keep it charged up; it comes with an adapter that lets you power up your phone and the Exo FingerMouse simultaneously.

What does it cost? The first 100 people to order can pick up the Exo FingerMouse for only £4, before it goes up to £5. Also available are a "limited edition" unit for £18, a "signature" version with your initials on it for £50 – and for £250, you can get one engraved with your name and be "enshrined" on the FingerMouse website as a "Founding Friend".

Likely to get funded?

At the time of writing, the Exo FingerMouse had raised only £54 of its £35,000 goal, with more than three weeks to go. However, it's on Indiegogo's "flexible funding" model, so the makers keep your money whether or not it's fully funded. Delivery is expected by June.

Link: pcpro.link/246exofinger

Coding challenge

Storing an image in the smallest file size possible

» Saving space with an invader

The amount of data stored on computers continues to increase – as does the desire to transfer it over the internet. So it's beneficial to squeeze our information into the smallest space possible.

To see how this might be achieved, let's use an image as an example. Imagine a 16 x 16 monochrome bitmap, such as the space invader image to the right. Each pixel can be represented by a black or white pixel, so the entire thing can be expressed as 256 bits of data. Can we devise an algorithm to store this image in a smaller space, in a way that can be easily reversed to recreate the original image?

The first thing to specify is that we want to recreate the image perfectly, rather than using a "lossy" compression method such as JPEG. Sometimes a little image degradation is an acceptable trade-off for a smaller file size, but in other cases only lossless compression will do. For written documents or computer code it's a must, since even the tiniest change might make the text incomprehensible, or cause a program to stop working.

We might start by translating our source image into a string of characters, each one representing either a black pixel or a white one. This gives us a set of 256 "B" and "W" characters, which includes lots of repetition (the graphic ends with 54 "B" characters in a row). Immediately this suggests a way we can save space – by notating the length of each series of pixels, rather than describing each one individually:

34B, 1W, 10B, 1W, 4B, 2W, 8B, 2W, 5B, 3W, 4B, 3W, 6B, 10W, 5B, 12W, 3B, 4W, 2B, 2W, 2B, 4W, 2B, 14W, 4B, 10W, 7B, 1W, 2B, 2W, 2B, 1W, 9B, 1W, 4B, 1W, 11B, 1W, 2B, 1W, 54B

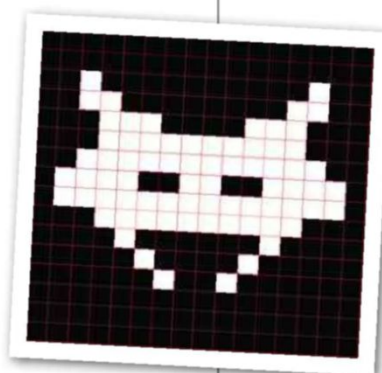
This method is known as run-length encoding, and here it has enabled us to significantly reduce the size of data. However, additional metadata will need to be stored to convey the width and height of the original image – and, for more complex images, the range of colours used.

An alternative way to compress the image is based on the popular Japanese game of Hanjie, which is like a graphical version of Sudoku. In this model, each column and row has one or more numbers associated with it, indicating which squares are to be coloured in black. If there are multiple numbers, it indicates that there's at least one white pixel (but possibly more) between sets of black pixels. If we encode our space invader graphic in this way, the third row comes out as 2,10,2 – indicating two black pixels, a gap, ten black pixels, then another gap, then two more black pixels. The second column is notated as 7,7, and so forth.

It's easy to create an algorithm to calculate the numbers for the rows and columns in this way. Decompressing the data, however, is more difficult, as an individual piece of data may not contain all the information needed to reconstitute a row or column. You could use brute force to decode the image one line at a time using a recursive loop:

Start with an empty white board

For every row in the image:



Position	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8,4 (far left)																
8,4 (far right)																
Overlap																

Find a possible interpretation of numbers for that row

Check whether it fits the column numbers

If the two don't match up, try the next possible configuration of that row

Once the two match, move on to the next row

How might we turn this into real code? If you were trying to solve the puzzle without a computer, you'd probably start by sketching out the grid on paper. For our program, the equivalent might be a two-dimensional array, along with a data structure to hold the numeric data itself.

There are some areas where efficiency can be improved. For example, rows and columns with 16 black boxes can be filled in right away.

Another trick you might try is aligning a sequence of pixels at the far-left-hand side,

with a single space between runs of black pixels, and then try lining it up at the far-right-hand side in the same way. Any pixel that "overlaps" in both arrangements must be solid – see the example above. If you work along

» An alternative way to compress the image is based on the popular Japanese game Hanjie

all columns and rows in this manner, you'll quickly work out many of the cells that have to be solid for the whole image.

As you can see, although solving the problem is a rewarding challenge, the decoding procedure is quite complex: this is why Hanjie tends to be used for puzzles rather than practical purposes! **DAVID HUNT**

Next steps

As we now have the luxury of good bandwidth and cheap storage by the terabyte, it may sometimes make sense to accept a larger file, rather than one that requires complex decoding. Software engineering is full of questions such as this, where the challenge isn't only how to implement your chosen system, but choosing the most appropriate system in the first place. Can you come up with a compression method that reduces file size without resorting to brute-force decoding?



CES is big business, says **Jon Honeyball**, and it's time the big players sat up and took notice

It sounds idyllic: extend your Christmas holiday by popping over to Las Vegas for the first week in January. Yes, I'm talking about CES, that industry melting pot where anyone who is anyone in tech will be there. Well, if you exclude Apple. And Microsoft. And Google.

Each year, CES gets bigger, louder and, supposedly, better. But some are claiming this year's event was a letdown, referring to the lack of a "kaboom!" industry announcement by someone huge.

This follows last year's CES, which was mostly progression based upon existing work. That said, the sight of Michael Bay, Hollywood director of the *Transformers* franchise, stumbling off stage during the Samsung keynote, apparently due to an autocue failure, is something I will remember for a long time.

This year, however, even the large-scale press conferences were boring, with little to show for the past 12 months. As always, there was a big push towards smaller, thinner and lighter devices with longer battery life and lower prices, all of which will appeal to the consumer. But there was little new in mobile, with most vendors holding off until Mobile World Congress in a few weeks' time.

You might think, therefore, that CES's time has come and gone. The reality couldn't be further from the truth. CES isn't merely a place to see new things, despite the huge cathedral-sized manufacturer stands and the dancing girls. It's a place to do business. My typical day runs from 7am through to midnight. Endless meetings, breakfasts, dinners, and then a flood of stand visits. I receive a triple-digit number of invitations to go and see some exciting new widget. Some PRs are quite pushy, insisting that I book my on-stand interview slot immediately because availability is scarce. Uh-uh, no it isn't – it's my time that's short.

One friend, a technical director at a UK firm, uses CES as the ideal opportunity to meet up with suppliers. He met with more than 40 of them in two days, which is the sort of workload that can bring a grown man to his knees. The younger manage to party on through the night, and innumerable stands are staffed by people in that post-zombie "I have been up for 36 hours" look.

My time at CES is a mix between wandering around the show floor, PR events and business meetings. And it's incredibly productive, if enough to flatten me for a few days once I return to the UK. I simply couldn't get through that amount of work in that time frame anywhere else on the planet.

This year, I carried around a pocket-sized Garmin walking GPS system with me. The squiggle of walking, taxis and rental car looks like a child has frantically scribbled over Las Vegas Boulevard with a crayon, as my path goes back and forth between the major hotels and the Las Vegas Convention Center.

And it is somewhat intriguing that all of this manages to happen without some of the biggest names in the industry being visibly present. Apple is never there, but then it never talks about any of its products in advance of its own carefully orchestrated launches.

Microsoft wasn't really there, either, although there were discussions taking place behind closed doors. Other big industry companies weren't visible either. But then, it's CES – the Consumer Electronics Show. What does Microsoft make in that space? There's its range of Surface tablets, and maybe a new mouse or keyboard to show. That's hardly worth a full stand. There might have been some presence for Xbox but, like phones, gaming has dedicated events later in the year.

And therein lies the problem. Far too much of this stuff is still too sandboxed, with product developments happening in contained spaces. Instead of a clear path forward, the whole industry seems to be groping around for a new direction, and in doing so is reaching out in several different directions simultaneously.

Yes, it mostly knows where it wants to go to, but the control, configuration and security aspects are making the public wary. We really need a vendor to step up to the plate and provide an open, free framework to make all of this stuff relevant and comprehensible to the home user. Niche vertical solutions won't work. We need a broader, more daring solution.

I'm hoping the big players were watching, and that at least one will have its act together for January 2016. It's time for someone to take the lead and make a bold push. Treading water does no-one any favours, especially those consumers the show aims to serve.

“We need a vendor to provide an open, free framework to make all this stuff relevant to the home user”

■ Jon Honeyball is a contributing editor to PC Pro. He has one word of warning if you ever go to CES: don't wear new shoes. Email jon@jonhoneyball.com



Chillblast

www.chillblast.com



GAME ADVANCED

GEFORCE® GTX™ 960.
POWERED BY
NVIDIA® MAXWELL™.



FUSION MANTIS

- NZXT Source 340 Mid Tower Case
- Intel® Core™ i5-4690K Processor
- Corsair H55 Liquid Cooler
- Gigabyte Z97-HD3 Motherboard
- **NVIDIA GeForce GTX 960 2GB**
- 8GB PC3-10666 DDR3 Memory
- 1000GB Seagate SSHD Hybrid Drive
- Corsair CX600 Power Supply
- Onboard High Definition Audio
- Microsoft Windows 8.1 64bit OEM

From **£849** inc VAT



FUSION PREDATOR 2

- Aerocool X-Predator X1 Evil Black
- Intel® Core™ i5-4460 Processor
- Arctic Cooling Freezer 7 Pro
- Gigabyte Z97-HD3 Motherboard
- **NVIDIA GeForce GTX 960 2GB**
- 8GB PC3-10666 DDR3 Memory
- 1000GB SATA 7200rpm Hard Disk
- Corsair CX600 Power Supply
- Onboard High Definition Audio
- Microsoft Windows 8.1 64bit OEM

From **£749** inc VAT



FUSION RAPTOR

- Phanteks Enthoo Evolv Case
- Intel® Core™ i7-4790K Processor
- Corsair H75 Liquid Cooler
- Asus Z97M-Plus Motherboard
- **NVIDIA GeForce GTX 960 2GB**
- 16GB PC3-12800 DDR3 Memory
- 120GB Samsung EVO SSD
- 2000GB SATA 7200rpm Hard Disk
- Corsair CX600 Power Supply
- Onboard High Definition Audio
- Microsoft Windows 8.1 64bit OEM

From **£1099** inc VAT



FUSION RHINO

- Biftenix Prodigy Case
- Intel® Core™ i5-4690K Processor
- Corsair H55 Liquid Cooler
- Asus Z97-I Plus Motherboard
- **NVIDIA GeForce GTX 960 2GB**
- 8GB PC3-12800 DDR3 Memory
- 1000GB Seagate SSHD Hybrid drive
- Corsair CX600 Power Supply
- Onboard High Definition Audio
- Microsoft Windows 8.1 64bit OEM

From **£899** inc VAT

5 Year Warranty with 2 Years Collect and Return with ALL PURCHASES

£15 OFF
ANY CHILLBLAST PC
CODE PCPDISC0215
USE THIS CODE AT THE CHECKOUT

Chillblast

e-mail: sales@chillblast.com
tel: 0845 45678 31
www.chillblast.com

The UK's most awarded PC Builder*

But don't just take our word for it...

- Five time winner of PC Pro Excellence Award!
- Four time winner of PC Advisor Best Desktop Brand!
- Builder of the World's Fastest PC!**
- Computer Shopper & Expert Reviews Best PC Manufacturer 2012

Terms and conditions are on the website. All trademarks are acknowledged. Pictures are for illustration only. Prices are correct at time of going to press (26-01-15) E&OE

* Chillblast won more awards in the leading IT press publications PC Pro, PC Advisor and Computer Shopper combined than any other retailer 2010-2013

** World's fastest PC as tested by PC Pro Magazine <http://www.pcpro.co.uk/reviews/desktops/371152/chillblast-fusion-photo-oc-iv>

Intel, the Intel Logo, Intel Inside, Intel Core, and Core Inside are trademarks of Intel Corporation in the U.S. and/or other countries.

Broadberry®

PetabyteRack™

1 PetaByte of RAW Storage in a Half Rack
under a single name space or volume.

...with Virtually Unlimited Expandability



Twice the Density
of other PB Solutions



Less than Half the Cost
of other PB Solutions



The Same Enterprise
Storage Features

PetabyteRack Features:

Up to 3.4PB in a Full-Height Rack

High Availability

Unlimited Maximum Volume Size

Caching, Compression, Thin Provisioning & Deduplication

Enterprise-Class SAS Hard Drives

VSS Compliant, VMware, Citrix and Hyper-V Ready

NAS (SMB/CIFS, FTP, Secure FTP, HTTP, NFS v2, v3)

1/10/40 GbE LAN Connectivity

Fibre Channel and Infiniband Options

Native, Tiered RAM and SSD Caching

Unlimited Snapshots, Replication

Configure from: £87,500

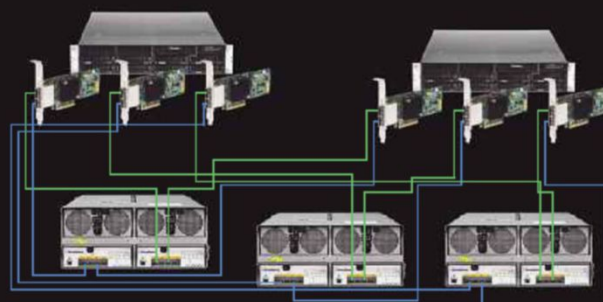
Enterprise-Class Petabyte Storage

Every aspect of the Broadberry Petabyte Rack has been carefully crafted to ensure easy maintenance, maximum performance, and the enterprise-class reliability Broadberry storage solutions have become renowned for. Find out more online.

CALL OUR SALES TEAM:
020 8997 6000

CONFIGURE YOUR PETABYTE RACK:
broadberry.co.uk/petabyterack

Example Windows 2012 R2 Storage Spaces Setup



Powered by the E5 2600
v3 Processor Family